MAY 5, 1958 PRICE 50 CENTS

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN
RESEARCH AND DEVELOPMENT

R&D RESEARCH and DEVELOPMENT news edition

GAS TURBINES...

their design future!... *see page 22*

SWISS DESIGNS...

see page 38

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another FULL-COLOR article

Our third full-color article for 1958 starts on page 34. It is an illustrated explanation of how Type C photographs are used in inspection, test and design.

There will be another in June, showing color "designed in" to a line of products for family resemblance and identification.

Still others are planned for later in the year. We will welcome your suggestions for further full-color articles and your comments about those published thus far.

These are unique editorial treatments in the field of design—a plus value in . . .

THE NEW Product Engineering

coming next week . . .

the DESIGN edition

for May 12

FEATURING:

- **Hopper feeders.**
  Single parts machine-fed to an assembly station for speedy operation.

- **Fewer experiments—same accuracy.**
  Latin squares deserve wider popularity as a statistical shortcut to design.

- **Clearance-hole and drill sizes.**
  Two recent developments combine to overcome the bugbear of tolerance buildup.

- **Pellet extrusions beef up magnesium structures.**
  Their compressive strengths promise radical design changes for large sections.

- **Hydraulic extrusion—Soviet style.**
  Much less pressure needed because a cushion of oil lubricates the billets.

- **Germanium and silicon rectifiers.**
  Semiconductors cost less than their rivals and they perform as well or better.

- **Midget batteries—power paths to new design.**
  Dramatic examples of how dc power packages have been miniaturized.

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

R and D RESEARCH and DEVELOPMENT news edition

May 5, 1958 Vol. 29, No. 18

FEATURED:

GAS TURBINES: THEIR DESIGN FUTURE. Look for them in automobiles, boats, earth-moving equipment, small aircraft, gas compressors and for portable power very soon 22

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Product Engineering .....SIDELIGHTS

R ESEARCH and news edition D EVELOPMENT

● **Where do ideas come from?** Find this mine, learn how to control creativity (p. 19) and you will have outstripped the best human minds that ever lived. Note, for example, this report from Bell Aircraft. The adhesives for metal-to-metal bonds in rotor blades are so strong the bonds simply cannot be disassembled for salvage or correction. This can be expensive. Some unsung genius thought to freeze the assemblies at −400 F and wallop them with a sledge hammer . . . at which treatment they fall apart as neatly as you please. But what gave him his hot hunch—to try refrigeration?

● **Shortly after preparation of final copy** for the color article on page 34, Kodak invited the editor and art director concerned to an exhibit of Type C prints at the Commodore Hotel. Clutching frosty glasses, our two adventurers plodded wide-eyed through acres of wall-sized full-color enlargements. We regret to admit that some of their enthusiasm for engineering illustration has cooled. Pretty as they may be, industrial photographs of rusty pistons or corroded armatures will never again arouse the excitement now reserved for Lilly Daché, pink champagne and black caviar.

● **Last week our chief editor** took off from Idlewild Airport on a six-week junket to London, Paris and points East (including USSR). Memos and editorials are already moving across the Atlantic at the speed of light and with the frequency of orbiting satellites. The sweet peace of a weekly publishing schedule has been replaced by a shuddering fear of teletype chatter. Cablegrams from exotic places create a modified form of delirium tremens at the prospect of another page torn up and reset. He may look as if he's just eating and drinking—but actually he's soaking up information like a sponge and spilling it out like an English geyser. Mata Hari and *femme fatale* needn't waste their time—everything he knows will appear in print sooner or later.

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ABP MAY 5, 1958

Product Engineering
A McGRAW-HILL PUBLICATION

Vol. 29, No. 18

PRODUCT ENGINEERING is published weekly,—with an additional Design Digest Issue in Mid-October, by McGraw-Hill Publishing Company, Inc. James H. McGraw (1860-1948), Founder. PUBLICATION OFFICE, 99-129 North Broadway, Albany 1, N. Y. See panel below for directions regarding subscription or change in address.

EXECUTIVE, EDITORIAL, CIRCULATION and ADVERTISING OFFICES: 330 W. 42nd St., New York 36, N. Y. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice-President; L. Keith Goodrich, Vice-President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice-President, Publications Division; Ralph B. Smith, Vice-President and Editorial Director; Joseph H. Allen, Vice-President and Director of Advertising Sales; A. R. Venezian, Vice-President and Circulation Coordinator.

Subscriptions are solicited only from executives, engineers and consultants engaged in the design of machinery and the other engineered products. **Position and company connection must be indicated on subscription orders. Send to address shown in box below.**

United States subscription rate for individuals in the field of the publication, $5.00 per year, single copies, fifty cents; Canadian subscription $7 per year; foreign $25 per year, payable in advance. Second-class mail privileges authorized at Albany, N. Y., U. S. A.

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PRODUCT ENGINEERING articles are indexed in both the **Industrial Arts Index** and the **Engineering Index.** PRODUCT ENGINEERING publishes its own annual index including the Design Digest Issue. Copies are obtainable on requests to the Editor.

SUBSCRIPTIONS: Send subscription correspondence and change of address to Fulfillment Manager, PRODUCT ENGINEERING, 330 W. 42nd St., New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address giving old as well as new address, and including postal zone number if any. If possible, enclose an address label from a recent issue of the magazine. Since copies are addressed one to two issues in advance, please allow one month for change of address to become effective.

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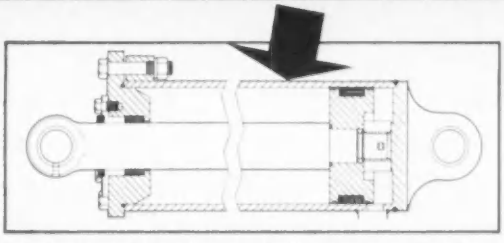
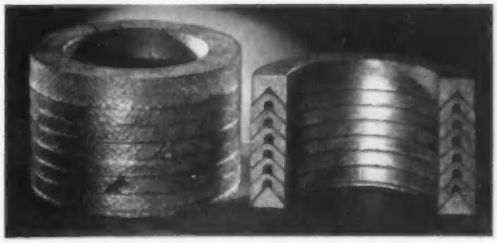


Drawing shows Garlock CHEVRON Packings on rod and piston of hydraulic cylinder made by Clark Equipment Company, Construction Machinery Division, Benton Harbor, Michigan. Note spool type piston made possible by use of cut open CHEVRON rings.



Typical CHEVRON Packing Set and cross section. Unique design provides automatic sealing action under all pressures . . . permits use of less packing in shallower stuffing boxes.

CHEVRON* Packings help simplify cylinder design and maintenance for CLARK

Garlock rod and piston packings on Clark's Michigan Tractor shovels are designed to give long trouble-free service and permit easy replacement. At the same time, Clark engineers have reduced manufacturing costs and simplified the piston design through use of Garlock cut open CHEVRON rings on a spool type piston. The packings operate against pressures to 1500 psi and temperatures to 180° F. Mr. M. L. Conrad, Director of Engineering for this Clark Division reports, "We have used Garlock CHEVRON rod and piston packings on this Tractor Shovel since it was first designed four years ago. The results have certainly justified such standardization."

CHEVRON is available for your application in sizes for practically any rod or stuffing box. It is another member of "the Garlock 2,000" . . . two thousand different styles of packings, gaskets, and seals for every need. The only complete line. That's why you get unbiased recommendations from your Garlock representative. Call him or write for CHEVRON Folder AD-115.

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READER TO EDITOR

A Gripping Hammer

To the Editor:

I noticed in your April 7 issue (Why Don't They R & D, p. 50) that a Mr. R. C. Gaston would like to have someone develop a hammer that would hold and dispense nails, one at a time. The Estwing Manufacturing Co. has recently placed on the market the new "3 in one" hammer.

One of its features is that, by using only one hand, a nail can be placed in the claw and set into a board.

—Ray O. Brown
Development Engineer
Estwing Mfg. Co.

• *This nail-in-claw method of holding a nail has been used by carpenters for quite some time. It also depends on the shape of claw and will not work with small nails. —Ed.*

Who's King of the Jungle?

To the Editor:

Please bear with me as I hasten to compliment you on your latest parable: eagle, lion and bear (Mar. 24, '58, p. 21). It shows an unusual imagination and ingenuity for an engineer, and I find it quite delightful.

I would say the bear was worse than you indicated, and the eagle a bit less than sensible. However, this is covered very nicely by Philip Wylie in his *The Innocent Ambassadors.*

A story I heard recently at a psychological round-table meeting fits the case: The lion knew he was the master of the jungle and all surrounding terrain. One day he started to wonder if all the other animals realized this, so he determined to find out by personal survey.

The first animal he met was a monkey. So the lion said: "Who is master of the jungle?" "Oh, you are, sir, you are," answered the monkey. Further along in his travels the lion met a zebra and, with bristling mane, demanded: "Who is master of the jungle?" Receiving an unsatisfactory answer, he was delayed a half hour. Having eaten all of the zebra he desired, he set forth to question the next animal, an elephant. Our lion braced himself and fairly roared: "Who is master of the jungle?" The elephant calmly wrapped his trunk around the lion and tossed him about 200 yards into a tall tree. Catlike, the lion landed on all fours, climbed down and rushed back to the elephant to whine: "You don't need to be so damn nasty just because you don't know."

—W. E. Greene
Los Angeles

The Search Has Ended

To the Editor:

Regarding your account of a device which reduces the force of gravity (*PE*—Mar. 10, p. 14). Are you kidding or is it for real? In a long search, I could find no reference to such a thing or even to a "Gravity Research Foundation" in any other magazine or newspaper. If such an effect has indeed been created, you owe your readers a much better description of it.

—J. L. Vail
Los Gatos, Calif.

• *The Gravity Research Foundation certainly is "for real." It is a 10-year-old association, founded by Roger Babson, with members from aircraft companies and research institutes. G. M. Rideout is president. Address: New Boston, N. H.—Ed.*

Name Correction

To the Editor:

This is in reference to the article, "Can We Design World Weather?" appearing in your March 24 issue (p. 23). We would like to point out that the correct name of our company is Meteorology Research, Inc., and not Meteorological Research Institute.

We will ge glad to send descriptive literature to anyone interested in the equipment mentioned in the article.

—Gordon Neiswanger
Vice-president
Meteorology Research, Inc.

• *Their address is: 939 East Union St., Pasadena, Calif.—Ed.*

American ...

DEVELOPMENTS TO WATCH...

Oils that qualify for service . . .

. . . at 350 F and above promise to do double duty as lubricants and hydraulic fluids. But the fact that they are available will pose new problems in metallurgy and bearing design.

With an oil-in temperature of 350 F, K. L. Berkey of Wright Air Development Center told the SAE Aeronautic Meeting some of the bearing temperatures are nudging 500 F—and type 52100 steel bearings are red-lined at this temperature. Actually, temperatures as high as 800 F have been recorded in the test engine sump area.

As speeds go higher, and operating temperatures rise, bearing temperatures at least as high as 800 F and gear temperatures of 600 F are to be expected. (Present service temperatures are 375 F and 250 F respectively.) Looking towards this day, WADC has prepared Target Specification Mil-L-9236 which defines an oil of 400-F bulk-oil temperature capabilities and, says Berkey, "most of the major oil companies, along with various chemical firms, are working on new fluids for this program."

Encouraging progress is being made. Shell Oil Company, for instance, says it now has an oil in production that it believes will qualify under 9236 and shows real promise as a hydraulic fluid as well. Shell calls it WRGL 34A.

Products that stay clean for good . . .

. . . free of bacteria through long-term use—can provide a new competitive edge for many industries. And formulators of a new class of compounds—"permanent" germicides—promise to make it possible. These compounds, which first made their appearance in textile products, are now being readied for incorporation in plastics, rubber and paper, and for use in metal finishes. They're not just surface treatments, but compounds that can be incorporated in the product, to stay there through repeated cleanings.

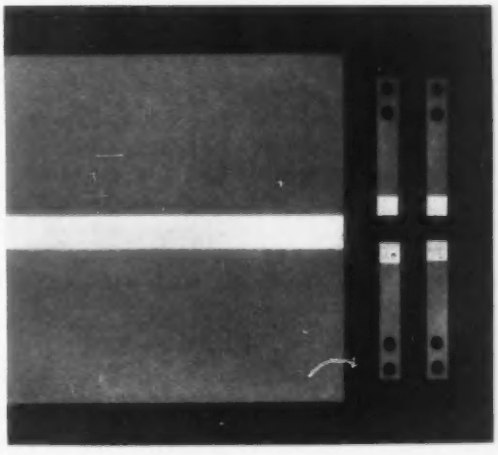
These compounds, their producers claim, will control an exceedingly wide range of microorganisms, including both gram-positive and gram-negative bacteria, as well as fungi; will withstand as many as 15 dry cleanings and 20 launderings without loss of effectivity; and have a service life of at least a year under normal use conditions.

As to treatment cost, estimates range from a fraction of a cent to about 2¢ per lb of treated material.

Who makes these chemicals? At least half a dozen companies, among them Bex Industries; Sanitized, Inc.; and Scientific Oil Compounding Co. All of these have been supplying such compounds to the textile industry for some time, but it's only recently that the possibilities of treating plastics, paints rubber and leather have received major attention.

Thermostat material with built-in contact stripe . . .

. . . can now be produced says General Plate Div., Metals & Controls Corp., Attleboro, Mass., using a new cold bonding ("cold welding") technique. Silver and silver-alloy stripes are inserted "inseparably" into thermostat metal, providing a continuous strip material that can be blanked to the desired shape, requires no separate operation for installing the contact point. The material can be made up to 3 in. wide with the inlaid stripe in the center as shown in the photograph; or about 2¼ in. wide if the stripe is off-center. Maximum thickness of the stripe is about 0.015 in.; with total material thickness about twice that.



Silver stripe bonded to thermostat metal makes it possible to turn out finished parts, often two at a time, without separate assembly operations.

American...

(continued)

DEVELOPMENTS TO WATCH...

Use glass fibers to pipe light . . .

. . . to instrument dials . . . use them in television, medical equipment, and photographic systems . . . try them as coding and decoding devices . . . suggests Narinder Kapany of Armour Research Foundation. He believes the applications of transparent fibers for conducting and controlling light far surpass those so far explored with glass and plastic rods. Such fibers, he points out, have the ability to isolate an element of an image and convey it to another point along a flexible path. Utilization of this ability deserves the status of a new branch of optics, he believes, and terms it "fiber optics."

By applying the principles of fiber optics, he says, it might be possible to build a new kind of color television system, in which colored glass fibers could be used for scanning and selective color pickup.

In coding systems, bundles of fibers, aligned at one end and deliberately misaligned at the other, could be used to scramble and unscramble pictures. And, says Kapany, this is only the beginning.

Tantalum as a heavyweight contender . . .

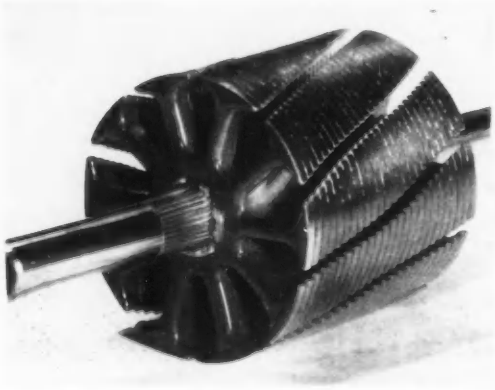
. . . is winning respect—and jobs. This metal is already valued for its corrosion resistance (in rayon spinnerets, acid-proof heat exchangers, and the like) and for its electrical properties (in tantalum capacitors and power tube anodes, for example). But the usefulness of its high density is only beginning to be recognized—primarily as a function of the strict design requirements of high-speed aircraft. Today, Fansteel Metallurgical Co. points out, air-foil sections are getting so thin that commonly used lead counterweights would be far too bulky, and heavy metal would be almost impossible to form into the convoluted shapes required. One part for instance is a bar, about 20 in. long, with a formed radius and a bend at one end. Despite tantalum's high cost (rod is about $60 a lb), the finished part is cheaper—and better—in tantalum than in any of the other materials that might be used. Tantalum's density is 16.6, as compared with about 16.8 for heavy metal, 19.3 for pure tungsten, and 11.3 for lead.

New route to high-purity silicon . . .

. . . is being explored by Foote Mineral Co., Berwyn, Penna. It's a modified iodide process that's said to produce material with an average resistivity of at least 100 ohm-cm (ranging as high as 3,000 ohm-cm) without zone purification. The material, as produced, is "p" type, with a lifetime of approximately 100 microsec. The process has now reached the stage where Foote is able to supply small samples for testing, and plans are being laid for considerably larger pilot-scale production.

Rotors without fishpaper slot insulation . . .

. . . rotors that can be wound directly—are being produced for small appliance motors and the like using a new coating process called "fusion bonding." An outgrowth of Polymer Corp.'s "Whirlclad" fluidized coating method, the new process is said to produce a resin finish that won't chip or flake at the corners, that coats slots and corners uniformly, and can be applied in thicknesses up to 0.050 in. Any one of several resins may be used this way—vinyl, epoxy, nylon.



Small appliance motor is insulated by new fusion-bonded coating. It's applied in one step instead of the seven operations required when fishpaper is used. Rotor here is 1¼ in. dia, 1½ in. long. —ARG

N. Y. Daily News Photo

New York's famous Coney Island boardwalk has undergone many changes in the last 35 years, but its old-time lampposts remain.

Corrosion-resisting Monel fastenings have held Coney Island lampposts securely for a generation.

35 years in salt and storm throw light on a common fastening problem

One of the lampposts on Coney Island's boardwalk was taken down recently . . . Inside its base, a three-inch layer of rust flakes. Under the rust, four Monel* nickel-copper alloy bolts and nuts, holding the post tightly to the boards.

Threads were as clean and sharp as new. An easy twist with a pliers, and out came each Monel fastening — as fit as the day it had been put in! (see photo at right)

Salt corrosion is just one of the tough operating conditions Inco Nickel Alloy fastenings and other parts meet successfully. They do outstanding service under conditions of cyclic stress . . . high and low temperature . . . acid, alkaline attack. Selecting a metal to overcome conditions like these? Get Inco's handy guide — "Standard Alloys for Special Problems" — yours for the asking. *Registered trademark

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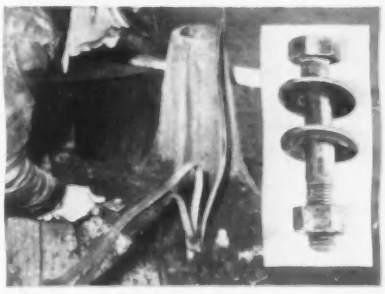

Bolt, nut, washers are still in excellent shape, little corroded after their long service.

INCO NICKEL ALLOYS

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world's finest drawing pencil

A.W.FABER-CASTELL

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Because its low index of friction makes each CASTELL stroke outstandingly smooth, a pleasure to work with.

Because our exclusive microlet-milling process reduces granules to optimum shape and size, producing an opaque adhesion that gives you cleaner, sharper blueprints.

We could talk about CASTELL's Color-Coding that makes for instant identification — its exceptional lead strength and durability, its fine-grained cedar wood impregnated with rare waxes, its perfectly-graded scale of 20 degrees, 8B to 10H.

But the really significant answer is — *almost 200 years of uninterrupted manufacturing experience–since 1761.* Perhaps the next 200 years will produce a markedly superior pencil, but if it does you can be sure it will continue to carry the A.W.FABER-CASTELL imprint.

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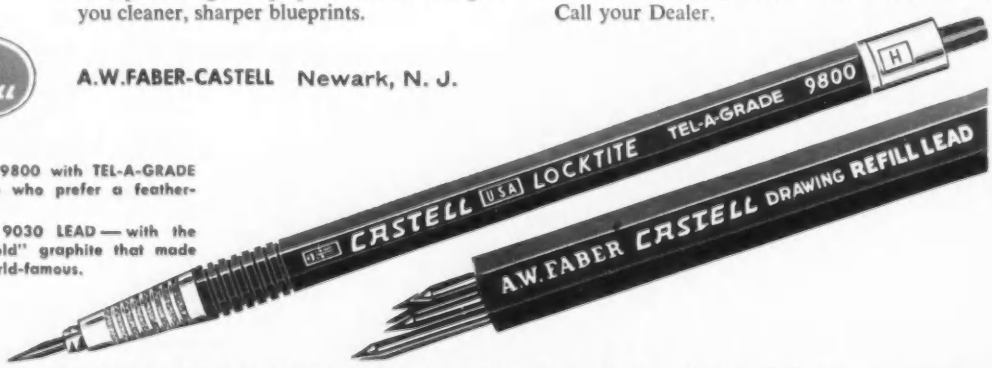
Imported CASTELL 9030 LEAD — with the identical "Black Gold" graphite that made CASTELL #9000 world-famous.



PREFERRED BY PROFESSIONALS IN EVERY CIVILIZED COUNTRY ON EARTH.

American ...Washington

DEVELOPMENTS TO WATCH...

Patent policy for atomic energy . . .

. . . may be in for a revision. The Atomic Energy Commission–for the first time–recently sat down with industrial contractors to air the matter.

Representatives of big contractors such as General Electric, General Motors, Allis-Chalmers, Esso Research & Engineering, Babcock & Wilcox, Armour Research and Atomics International (North American Aviation Co.) let loose a barrage of criticism. The big change that industry wants from the government is the elimination of section 152 of the Atomic Energy Act which automatically gives the government ownership of all inventions developed under commission contracts, unless waived by the commission.

It should be replaced, the industry spokesmen told the AEC, by a policy similar to the one used by the Department of Defense. In such cases, the government retains the right to use the invention royalty-free, but the inventor has the right to license and collect royalties for any non-government use.

A three-man panel to advise the AEC on patent policy is sifting through the industry arguments now. Guessing is that the panel will go along with industry–at least part way–in its recommendations.

Navy will pump more money . . .

. . . in the coming year into its program for the direct conversion of heat to electricity through thermocouples. (See also Apr. 28, '58, p. 33; Apr. 21, '58, p. 16). Navy's prime interest: as a propulsion system in its nuclear powered submarine. Big advantages would be: the weight reduction and the elimination of turbines and generators that would cut down on the noise and make subs harder to detect by the enemy; and weight. The ultimate goal is a method of propulsion to completely eliminate the propeller and shaft.

Admiral A. M. Morgan, Assistant Chief of the Bureau of Ships for design and research says that the Navy project is supposed to be as efficient as conventional power plants requiring steam turbines and a generator.

Right now, Navy is testing materials to find out which ones are best for thermocouple use and how they stand up under radiation. Designers are working on the best configuration of the heat source. One source says the Navy hopes to have a pilot plant working within the next 18 months. Within five years it expects to have the propulsion system in use.

Although Navy won't give details on its program, reportedly it will use a tandem set up combining two approaches, thermionic and a semiconductor method for example. The waste heat from the first system would become the heat source for the second one. Together they would give an efficient operation. The program is under strict security wraps Navy officials won't discuss it.

Other services are pumping money into thermocouple electricity program, too. Army wants to use it for field communication, possibly to power tanks and other field equipment. The Air Force is considering using the jet exhaust heat to power auxiliary equipment in the plane.

Industry has cut back on its recruiting . . .

. . . of college engineering and science graduates, according to a recent poll made by the Engineers and Scientists of America.

It surveyed 103 universities having a total of 31,315 June graduates coming up–including B.S., M.S. and Ph. D. degrees. The results: 59 schools reported recruiting activity below the 1957 level; 8 greater than 1957; and 34 about equal to 1957. Two schools didn't reply to the survey.

A number of schools indicated that they are entertaining the same number of companies as in the last two years, but that in many instances the companies are just looking at possible candidates for the future; such companies having no openings at the present time. Some of these companies hope to have openings by June.

Company recruiters are more selective this year than they have been in previous years, said 98 schools. Six universities reported that industry is only interested in the upper 10% of the class; 27 reported interest in only the top 25%; and 54 had interest across the board.

World-wide ...

DEVELOPMENTS TO WATCH...

Bench-size model-making machines . . .

. . . that can be used for low-cost fabrication in plastic of prototype sections (gas tanks, machine guards, fairings, housings) and machined parts are coming on the market both here and abroad. These are simple machines, designed for flexibility rather than speed or low-cost production; but just the thing for the designer who wants to get a quick look at his product-to-be.

Already available in this country is a portable vacuum forming machine that weighs only 35 lb and plugs into any 110-v outlet. It has a 9-by-9 in. forming area, and will draw up to 4 in. in depth, is priced at $155.

Now, a British manufacturer is introducing an injection molding machine weighing 80 lb that fits in a case 13 by 16 by 16 in. It has a 220/240-v ac heater, draws 250 watts, has a temperature range of 0 to 570 F, can handle both regular and linear polyethylene, nylon cellulose acetate, vinyls, and other thermoplastics. It's made by S. R. Seymour & Co., Brook Road, Rayleigh, Essex, is priced at $385 c.i.f. New York.

Designed for the road . . .

. . . These two new products, built for the auto industry, offer portability as a key feature, and have other interesting design features as well. One is a portable brake tester, made in England (photo below, left); the other a portable battery charger from Australia.

Recording system of the brake tester uses a pendulum-mounted pen damped by a simple magnetic current damper to chart braking action on a removable card. According to the manufacturer, V. L. Churchill & Co., Ltd., Bedfont, Feltham, Middlesex, the damping action is directly proportional to the velocity encountered during braking. The instrument is not affected by speed or front-end movement, and gives a direct measurement of over-all braking efficiency as well as an indication of side pull during braking.

The battery charger is a 25-amp unit, to charge 2, 4, 6, or 12-v batteries at rates from slow to medium. It has a selenium rectifier and sports big, easy-to-read dials. Replex, Ltd., of Brunswick, Victoria, says it is considerably more versatile than earlier models, will handle one battery or several at a time.

Brake tester weighs 28 lb, records brake efficiency and side pull on removable permanent-record card.

Portable battery charger made in Australia weighs less than 40 lb, operates on 220/250 v ac.

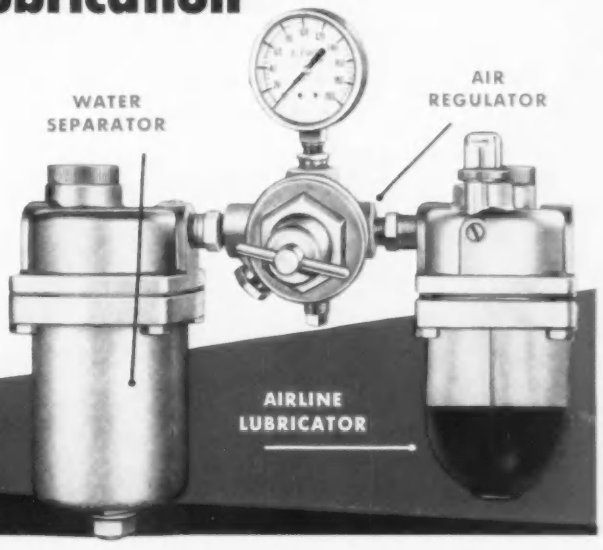
Alemite "Tri-Duty" air line controls!

All-New...for the cleanest, driest, best-regulated air line lubrication

Automatic Water Separator! Removes all of condensate, all the time. Traps dirt particles to prevent damage to sensitive air line devices. Handles all air line pressure up to 200 PSI and flow volume from 5 to 50 CFM.

Air Regulator with Gauge! Assures accurately controlled air – prevents erratic operation and damage to equipment. Adjusts to any pressure up to 200 PSI.

Automatic Air Line Lubricator! Provides automatic lubrication to air-operated mechanisms. Air stream controlled by compensating Venturi valve. Nine-ounce capacity.



All-New features offer outstanding advantages:

1. Single Unit Control Lubricator. Regulates the exact oil output required.

2. Visual Oil Counter. Oil sight dome in lubricator permits visual observation and count "per-drop" of lubrication.

3. Uniform Oil Mixture. Regardless of air pressure and volume!

4. Consistent Output. Oil and air mixture proportionately constant.

5. Easily Installed. Straight "inline" pipe connections . . . ½" p.t. inlet and outlet ports.

6. Wide Oil Range. Handles all viscosities of oil up to 500 SSU at 100° F.

7. Continuous Operation. Oil reservoir is refillable while unit is in operation.

8. Instant Oil Feed. For intermittent or continuous tool operation—no lag!

9. Filter Oil Tube. Removes all contamination from oil passing into air line.

10. Concentric Venturi Design. Assures constant, uniform mixture of air and oil.

11. Contamination-Free Air. Removable strainer in Air Regulator traps minute dirt particles.

12. Effective Control of Air Flow. Air Regulator eliminates excessive pressures and sudden surges.

13. 100% Condensate Removal. Water Separator removes and automatically dumps 100% of the condensate present in air lines.

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What's happening in SCIENCE

Fluid dynamics moves ahead

Call it *magnetohydrodynamics, magneto-fluid dynamics, magneto-gas-dynamics, hydrodynamics,* gas *dynamics,* or *magneto-aerodynamics,* the science of controlling fluid flow is making real progress, technically as well as in the number of names applied to it.

Magnetohydrodynamics, as it is most often called, makes use of the fact that ionized air and electrically conducting fluids can be controlled by the application of electrical and magnetic fields. With it, scientists are seeking new ways to protect aircraft from friction-heated gases (*PE*—Mar. 3, '58, *p.* 18). It may also provide the basis for new forms of propulsion (*PE*—Sept. 23, '57, *p.* 17) and a solution to thermonuclear problems. Research is being pushed by many aircraft companies and sponsored by AEC, NACA and other government agencies. Among recent findings: A magnetic field transverse to the flow of a conductive fluid across a flat plate causes a reduction in both heat transfer and skin friction, but an increase in total drag force on the plate.

Hot line to the *Hot Shot* aids space studies

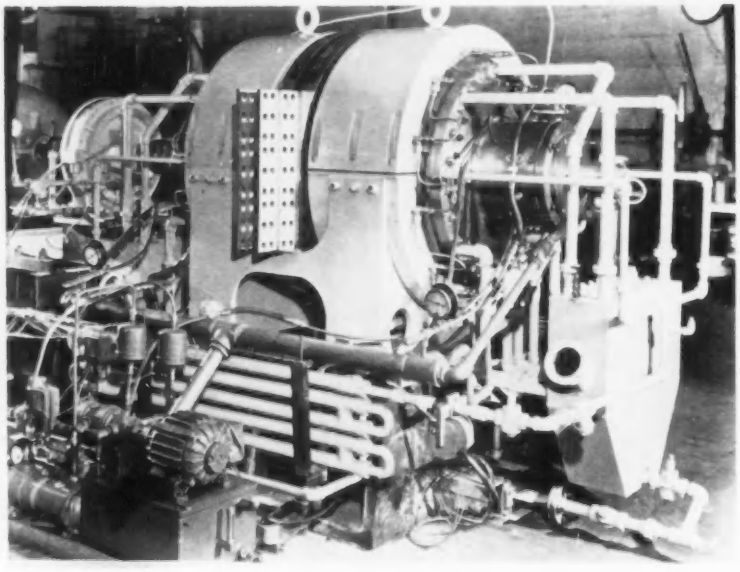
To simulate "escape conditions"—speeds in excess of 32,000 mph at temperatures beyond 40,000 F and pressures above 30,000 psi—and study the phenomena of gas dynamics, Arnold Engineering Development Center is building a super-wind tunnel, the "Hot Shot II."

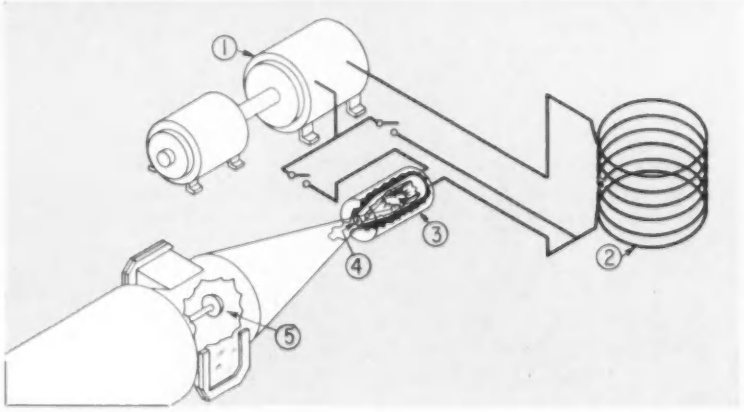
To meet its energy needs, something special was required. The rectifier-and-capacitor hookup generally used to build up energy and reach the desired temperatures and pressures just wouldn't do. The 6000-kw generator pictured here seems to be it. Built by Allis-Chalmers, the unipolar machine features a liquid metal "brush"—actually a sodium-potassium bath—which substitutes for the conventional carbon brushes, has a capacity of more than 80,000 amp, and an efficiency of more than 98% at 3600 rpm.

space briefs . . .

Three types of control systems may be applied to space rockets, says W. M. Borman of Armour Research Foundation. But all pose severe limitations on maneuverability, for the present at least. The reason: all three depend on power from the rocket itself or on auxiliary fuel. One employs vanes inserted in the exhaust stream; a second takes advantage of the fact that a rocket will travel in the direction of its thrust, and uses gimbels to rotate the rocket combustion chamber; the third utilizes small side-directed rockets fired in response to command changes.) The answer: new forms of propulsion—and new control systems.

Hotter than a pistol will be a literal description for the X-15, predicts North American Aviation. This stainless steel plane, built to "fly man higher and faster than he's ever been, will actually glow red like the iron in a blacksmith's forge as it plunges back into the earth's blanket of air." It has been designed to stand temperatures ranging from a top of 1000 F down to minus 300 F (condensation point for liquid oxygen). —ARG





Big generator (shown above on test stand) feeds current to inductive storage coil (2) which provides energy to arc chamber (3) closed by plastic seal (4). When plastic vaporizes, hot gas is released to tunnel (5) containing test part.

One set of spare parts serves all these 18 HERCULES engines

Here's parts interchangeability to warm a maintenance man's heart! Hercules designed the new DD diesel and GO gasoline engines with the user in mind: succeeded in achieving a unique degree of interchangeability that reduces spare parts requirements for Hercules-powered equipment to a minimum.

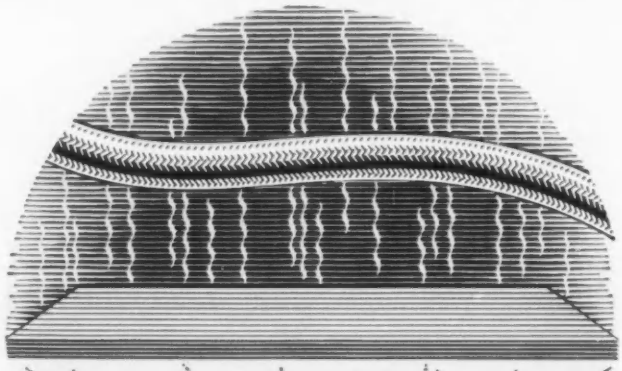
Actually, the illustration above doesn't tell the whole story. To do that, we'd have to show 6 power units as well as all 18 models of 3, 4, and 6-cylinder engines available in the DD and GO series—a total of 24 power plants using many of the same wearing parts!

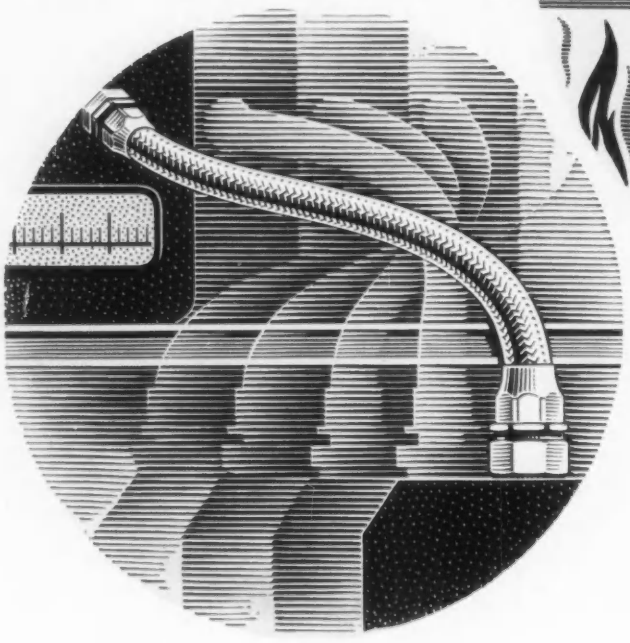
This maintenance economy is another reason you should specify dependable Hercules gasoline, diesel, or LP-gas engines for the equipment you build. For the full story on these engines, write Hercules Motors Corp., Canton 2, Ohio—or call your Hercules distributor: there's one in the Hercules worldwide network near you.

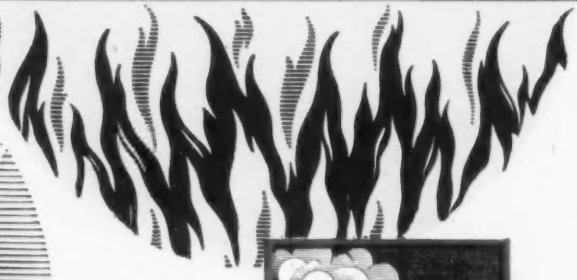
HERCULES

HERCULES MOTORS CORPORATION
Canton, Ohio

Do your fluid lines have to overcome heat and vibration?







Specify hose of TEFLON® TFE-fluorocarbon resins for safe, reliable operation

Heat, vibration, flexing—these are factors that make ordinary hose deteriorate rapidly. Not so with hose of TEFLON* TFE-resin. It provides safe, reliable operation up to 500°F. under the toughest conditions.

See the other advantages: Hose can be built to withstand 3000 psi and can handle superheated steam without failure. Chemicals in normal industrial use have no effect on TFE-fluorocarbon resins. Hose of TFE resin repels adhesion of sticky substances, is non-aging. It remains flexible at 30°F., has been used even in liquid oxygen service.

So, for really reliable hose installations . . . for better market acceptance of your products . . . see what hose of TFE resin can do for you. Call your hose dealer or write to: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept., Room **365**, Du Pont Bldg., Wilmington 98, Delaware.

In Canada: Du Pont Company of Canada (1956) Limited, P.O. Box 660, Montreal.

*TEFLON *is Du Pont's registered trademark for its fluorocarbon resins, including the TFE (tetrafluoroethylene) resins discussed here.*

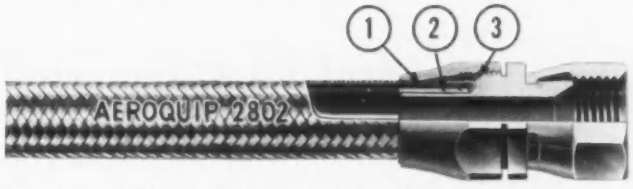
DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

For Top Performance and Economy... Use Aeroquip Hose of Teflon and Reusable "*super gem*" Fittings

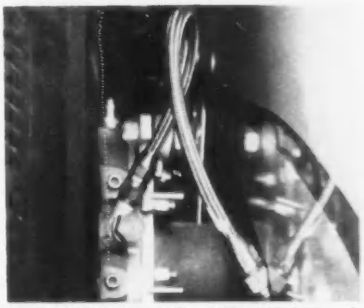
FOR ALL CHEMICAL, STEAM AND HIGH TEMPERATURE FLUID SYSTEMS



This cutaway view shows how Aeroquip patented* "*super gem*" Fitting seals 2802 Hose of Teflon to protect against leakage at all pressures: Compression of wire reinforcement (1) assures positive grip and lasting protection against fitting blow-off. (2) A lip seal is formed by the tube of Teflon seated, but not compressed, between the nipple and sleeve. (3) a metal-to-metal line seal is formed by the mating of the nipple and sleeve.

Hose lines of Teflon make possible prolonged service of fluid lines under extreme fluid temperatures or where chemical stability, lubricity and flexing cause design or maintenance problems.

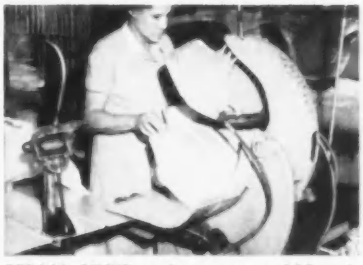
Use of the reusable "*super gem*" Fitting on Aeroquip 2802 Hose of Teflon assures top performance and economy. This unique Fitting provides permanent protection against leakage, yet detaches quickly for modification or reuse on a new hose. Only bench tools are needed to assemble or disassemble any 2802 Hose Line.



LOW VOLUMETRIC EXPANSION of Aeroquip 2802 Hose of Teflon makes it ideal for braking or actuating systems. Installation seen above is front wheel hydraulic brake line on winning car of Indianapolis '500' race.

CHEMICAL STABILITY AND INERTNESS of 2802 Hose of Teflon above are proved in more than a year's service conveying methylene chloride, solvents and aerosol products. Detachable "*super gem*" Fittings of corrosion-resistant stainless steel match hose durability.

FLEXIBLE HOSE OF TEFLON replaces steam pipe with leaking swivel joints to eliminate constant maintenance problem on this tire curing mold. Hose line was assembled in plant, using ordinary bench tools.



STEAM LINES under constant 100 psi. pressure flex 2000 times a day on this laundry pressing equipment. User reports leakproof performance with Aeroquip 2802 Hose of Teflon, even after months of service.

AIR COMPRESSOR DISCHARGE LINE is made of 2802 Hose of Teflon to resist effects of heat buildup and vibration. Service life of Hose is practically unlimited in this and many other applications with temperatures up to 500° F.

GOOD LUBRICITY of Aeroquip 2802 Hose assures quick drainage and flushing of paint spray lines and transfer or processing lines.

Aeroquip

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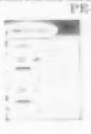
Teflon is DuPont's trade name for its tetrafluoroethylene resin
"*super gem*" is an Aeroquip trademark. *U.S. Patent Nos. 2,833,567 and 2,731,279

PE-5

Aeroquip Corporation
Jackson, Michigan



Please send me Industrial Engineering Bulletin IEB-268 on reusable "*super gem*" Fittings and Hose of Teflon.

Name_____

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Company_____

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What's happening in MATERIALS

How to catch a microwave

Microwave absorbers provide a good example of materials development to meet the needs of design engineers.

These absorbers serve as "deadeners" for the ultra-short waves used in many advanced communications and guidance systems. Among other things, they make it possible to simulate echo-free rooftop conditions indoors so microwave equipment tests need not be interrupted by weather.

From a few "special" materials known to have absorbent characteristics, the collection of such materials has grown to major proportions. It now includes everything from paper and foamed plastics to rubberized, curled animal hair, a material generally encountered in sofa cushions. Each, of course, has its job to do:

Some, like paper and curled hair, are relatively low cost.

The foamed and sponge types are easy to handle and apply.

For extreme conditions of power concentration, there are glass-fiber materials which are completely fireproof (most of the others are at least fire-retardant), and can dissipate up to 3 watts/sq/in.

Name your needs, say the producers —and we'll have the material.

Our own glossary

II—Nef families

New kinds of plastics are appearing like rabbits out of a hat—so fast it's difficult to remember which does what. Here, then, is the second in a series of brief guides. (The first appeared two weeks ago.)

Polyolefins: One member of this group, polyethylene, is well-established but others are just coming into view. All are polymers of the olefin group of organic chemicals—starting with ethylene (two carbon atoms), and building up through propylene (three carbons), butylene (four carbons), and so on. Those made so far are all resistant to chemicals, relatively soft and waxy in appearance, with good electrical properties, and potentially low in cost.

Polycarbonates: Only one member of this family has so far been introduced in this country: GE's Lexan. But toughness, clarity, and heat resistance (it has an unusually high heat-distortion temperature for a thermoplastic) promise others to follow.

Acetal resins: Of this group, too, there is only one thus far: DuPont's Delrin. It's a linear addition polymer of formaldehyde, strong and tough, boil-resistant and with good dimensional stability and fatigue life. Potentially low in cost, it's expected to be suitable for many mechanical parts.

Resin temperatures going up

Resins can be developed for service at 2500 F and above, say Walter Brenner and Charles Marsel of NYU —if engineers go after them with imagination as well as determination. Inorganic and semi-organic polymers with a heat resistance of at least 1000 F, and perhaps 2500 F, are "distinct possibilities."

Combination materials, using inorganics and organic binders are already available for service at 6000 F, and recent reports indicate that several companies are developing materials that can resist short-term exposure to temperatures as high as 12,000 F.

Haveg Industries, for instance, has a group of materials that Reinhold Engineering is now fabricating into such parts as blast tubes, insulators, rupture disks, jet vanes, and nose cones for services at close to 6000 F.

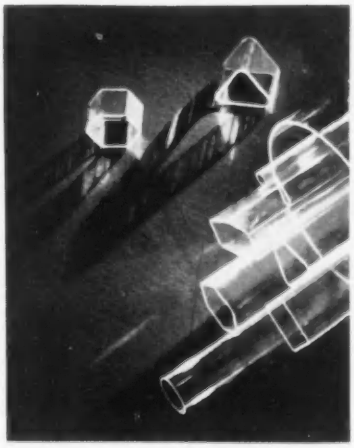
These materials obtain their heat resistance by taking advantage of both insulation and reflectance to dissipate heat. Says John H. Lux, president of Haveg Industries: "At high temperatures, the organic binder is pyrolized or reacts slowly with the high-melting inorganic silicates, giving a surface which has the ability to resist erosion and the conductance of heat, while most of the energy is reflected from the surface and subsurface back into the flowing stream of gases."

briefs . . .

An ozone-resistant rubber that "forms a virtually impenetrable barrier to air and most other gases, even under extreme pressures," has been unveiled by B. F. Goodrich. Three years in development, and not previously publicized, its first big-news job was in the pneumatic system for the Jupiter C. Goodrich says it's a special styrene-butadiene compound that also offers unusually high flex life, and will stand repeated cycling from zero pressure to 3,000 psi. Operating-temperature range is minus 65 to plus 200 F.

Enameling steel can now be supplied in coils 24 to 60 in. wide by US Steel Corp.'s Irvin Works. According to USS, this represents the first commercial availability of enameling steel (16 to 22 gage) in this form, and much of it will go for home-appliance use.

More shapes broaden design possibilities for fused quartz. In addition to forged domes and prisms (*PE—Mar 31, '58 p. 35*), it's now possible to get tubing with square, triangular, and other noncircular cross-sections (photo below). The high melting point of this material (above 3000 F) plus its optical and electrical properties, make it of interest to designers in a good many fields. —ARG



Fused quartz, in odd shapes like these, may now be obtained from GE at prices "only slightly higher than that of standard round tubing for use as insulators, covers.

Hospitals will welcome this new lightweight sterilizer tray made of heat-resistant MARLEX . . . withstands sterilizer temperatures up to 250° F. for hours!

MARLEX tote boxes filled with chickens moving into this quick-freezer easily withstand repeated freezing and steam cleaning, as well as the usual severe production-line handling.

The best tote boxes are made of MARLEX*

RIGID POLYETHYLENE

. . . lightweight, unbreakable, low in cost!

"We picked Marlex because it has what it takes to deliver satisfactory service in restaurants, cafeterias, hotels, hospitals, and the institutional food field," says Daniel Bloomfield of Bloomfield Industries, 4546 West 47th Street, Chicago 32, Ill.

"Here is a tough, rugged plastic that is completely sanitary," Mr. Bloomfield points out. "You can put our new Marlex All-Purpose Dish Boxes and Silverware Trays through commercial cleansing procedures.

"Marlex doesn't stain from oils, fats or greases. It won't dent, either. So this equipment keeps its good looks. And the price is right."

Injection-molded restaurant equipment is just one of many profitable applications for Marlex polyethylene.

No other type of material can serve so well and so economically in so many different uses.

For more information, get in touch with your local Marlex sales representative.

*MARLEX is a trademark for Phillips family of olefin polymers.

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Take a new look at

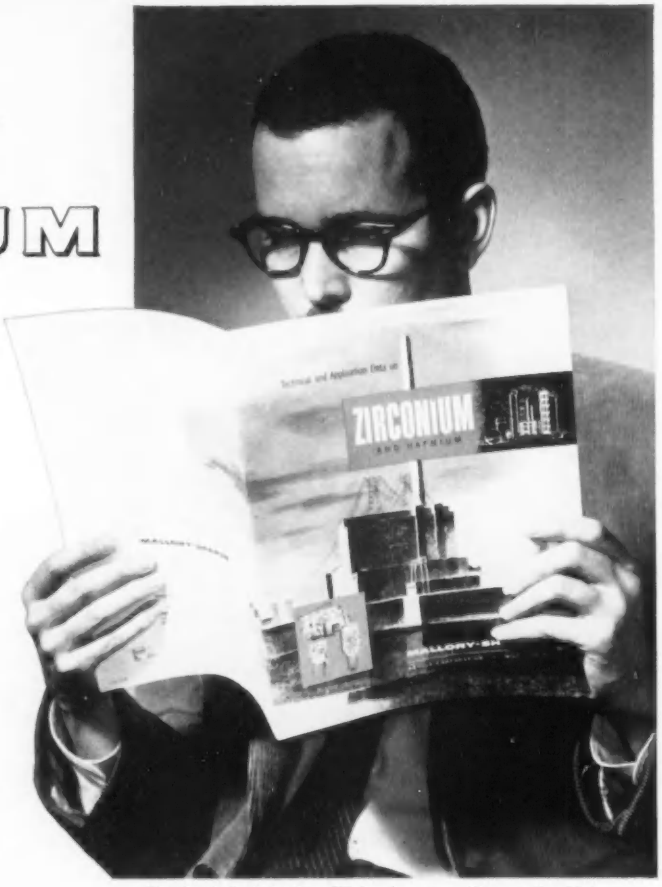
ZIRCONIUM

Now zirconium takes another giant step ... from an expensive rarity to a readily available special-purpose metal. Capacity is now on hand for not only A.E.C. requirements but also commercial markets. And, as in titanium, Mallory-Sharon is in the forefront of this rapid development.

A modern, highly efficient zirconium and titanium sponge plant at Ashtabula, Ohio, now makes Mallory-Sharon the largest single source of metallic zirconium, and its by-product, hafnium.

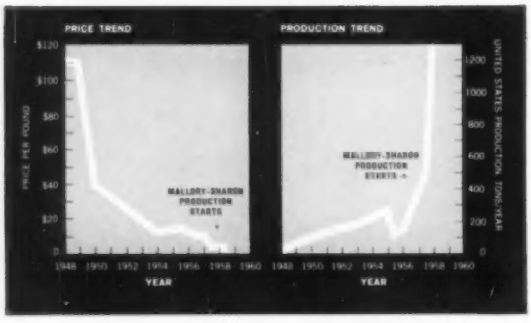
Mallory-Sharon's integrated production facilities ... from raw materials through finished mill products ... mean *greater availability* and *lower costs.*

We're ready *now* to help you explore practical commercial uses for zirconium. Write us for technical information, or engineering assistance on specific applications.

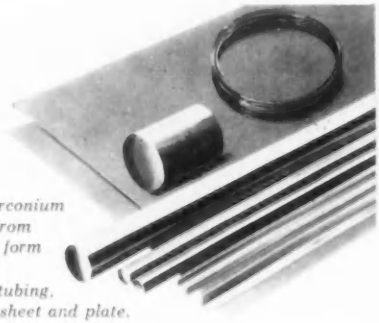


For technical facts – *Write for new 16-page booklet, giving technical and application data on zirconium ... its excellent corrosion resistance to most acids, alkalies and combinations of these media ... its remarkable nuclear properties.*

For availability – *As Mallory-Sharon's large, modern, sponge plant reaches full production this year, zirconium becomes readily available for all commercial applications.*



For lower prices – *Greater availability will definitely be reflected in lower prices. In many cases, the improved performance of zirconium parts much more than offsets their higher material cost.*



For mill products – *Zirconium is now available from Mallory-Sharon in the form of rounds, bars and billets, wire, tubing, strip, foil, sheet and plate. Quality and properties are carefully controlled at every stage of production.*

MALLORY SHARON

MALLORY-SHARON METALS CORPORATION · NILES, OHIO

Integrated producer of Titanium • Zirconium • Special Metals

the *Elusive* idea

Half a dozen years ago, John Arnold created a mild sensation in educational circles with his course in creative thinking at MIT. He had his students design everyday kinds of equipment for most unusual "people", the beings on a planet called Arcturus. The beings were shaped differently than we, and the atmosphere and other conditions of their planet were different too. So the usual rules didn't apply.

Some of the more ingenious products of these students made newspaper headlines. But there was much more to it than that. Professor Arnold was seeking to develop the latent creative ability in his engineering students. Many another professor has tried to do the same thing. This is because we as a nation need creativity desperately—not only in design, but also in the arts.

Creativity, says the *Harvard Business Review*, is like peace: Everyone wants it, everyone seems to have some ideas about it, but nobody seems able to produce it.

We have, however, begun to learn some things about it. Some of them are logical, some quite unexpected. Here are a few:

1. Creativity in design, art, marketing—in fact, in all fields—is interrelated. Thus the mind that can create in one field can create in another.

2. Creative people, surprisingly, place more emphasis and importance on utility and practical matters than their less-creative colleagues.

3. "Brainstorming" actually inhibits creativity rather than fosters it, according to a recent study at Yale.

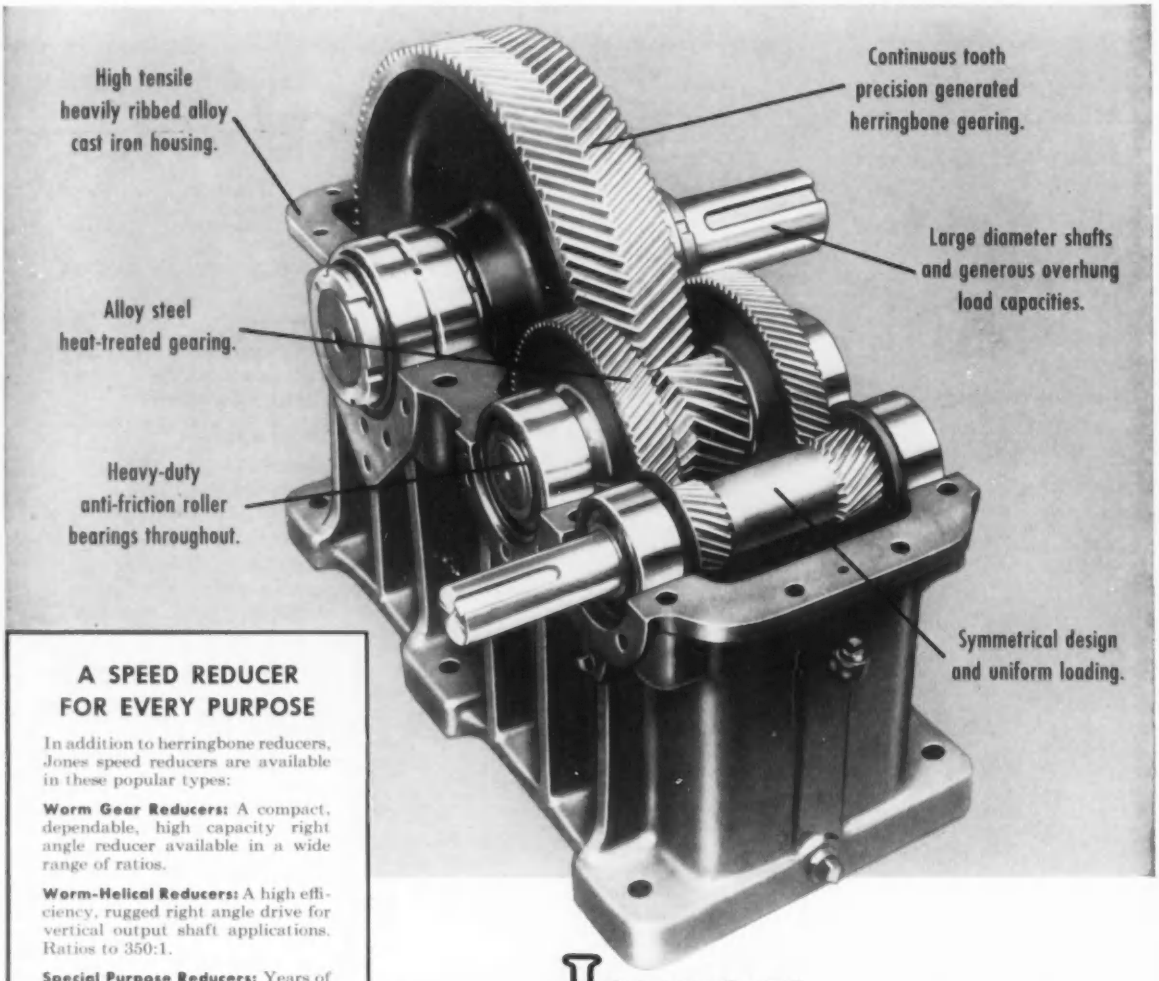
4. "Crash programs" are almost invariably fatal to creative effort—hence the recent emphasis on "brain parks," the sylvan settings where creative people can be comfortable and unbothered.

5. The average age of maximum creativity in Nobel Prize winners is 36 years. As somebody has said, the "best years of a creative man's life are between the ages of 36."

6. "Managing" creative people is a major impeding factor. A recent survey among creative people cited this impediment in 39% of the cases.

There is much more to be learned about the creative process. We must continue to learn because creativity is the "missing link" between the practical and social sciences, between what we are and what we may become, between man and his future.

K. J. Krafsman


High tensile heavily ribbed alloy cast iron housing.
Continuous tooth precision generated herringbone gearing.
Large diameter shafts and generous overhung load capacities.
Alloy steel heat-treated gearing.
Heavy-duty anti-friction roller bearings throughout.
Symmetrical design and uniform loading.

A SPEED REDUCER FOR EVERY PURPOSE

In addition to herringbone reducers, Jones speed reducers are available in these popular types:

Worm Gear Reducers: A compact, dependable, high capacity right angle reducer available in a wide range of ratios.

Worm-Helical Reducers: A high efficiency, rugged right angle drive for vertical output shaft applications. Ratios to 350:1.

Special Purpose Reducers: Years of enclosed gear drive design and manufacturing experience at your service where special purpose reducers are required.

ONLY Jones GIVES YOU ALL THESE QUALITY FEATURES IN THE EXACT SIZE FOR YOUR NEEDS

Here's why these design features enable Jones Herringbone Gear Speed Reducers to stand up to hard service in all industrial applications:

Precision generated herringbone gearing of rugged heat-treated alloy steels gives these reducers the toughness to carry heavier loads, provide smoother operation, and give longer service life in the most strenuous applications. *Anti-friction bearings*, conservatively selected, provide continuous accurate gear alignment and maximum efficiency at all speeds from start to full load. *High test alloy iron housings* mean rigid protection for gears and bearings and prevent damaging deflection or distortion. *Splash lubrication system* keeps a continuous supply of oil flowing to all rotating parts, insuring trouble-free duty. Shaft extensions and joints are effectively sealed to keep oil in and dirt out.

Balanced design and top quality features such as these spell out savings through low maintenance costs, efficient operation, and exceptionally long service life. Jones Herringbone Gear Speed Reducers are available in 57 standard sizes with mechanical capacities up to 1950 H.P. and a wide variety of ratios to permit economical selection of the proper unit for each application. To find out how H-R products and services can help you, consult your classified telephone directory for the nearest H-R representative, or contact Hewitt-Robins, Stamford, Conn.

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INDUSTRIAL HOSE . . . VIBRATING CONVEYORS, SCREENS & SHAKEOUTS

Ask More Info on Automated Tools

DETROIT—Tool engineers are intensely interested in applying programmed machine tools to short production schedules, but most engineers have too little information to judge the feasibility of automatic equipment in specific jobs. This keen-interest-little-knowledge attitude of engineers is revealed in a study just released by the American Society of Tool Engineers.

Other views reported are:

Larger plants—those employing more than 10,000—are doing the most pioneering in numerical control. And most of the large plants are in the aircraft industry. Industrial spending on numerical controls will probably top a half-billion dollars in five years.

Drilling is named as the process most applicable to programmed controls, regardless of plant size.

Labor saving is the key factor considered by tool engineers contemplating adoption of automatic controls. Savings in machine time, improved accuracy and reduced equipment requirements are conisdered secondary.

High costs, complicated systems, and lack of standardization are cited as the main handicaps to acceptance of programmed machine tools.

Guided missile sub . . .
Navy's new SSG FBM slated for construction in 1959, designed to carry the fleet ballistic missile, will be nuclear-powered and reputed able to remain on-station undetected for lengthy periods. The sub will also carry sonar equipment and torpedo tubes.

Computer Handles AF Logistics Job

NORTON AFB, CALIF.—An IBM 705 computer backstopped by a ballistic missile manager will handle logistics for the Titan ICBM and the Thor IRBM at a new Air Force data processing center opened here.

Assuring 24-hr combat readiness for missiles compounded of 100,000 parts and assemblies at far-flung launching sites is a logistics problem vastly more complex than any yet experienced by the Armed Forces officials say.

The IBM 705 is linked by a communications network with the missile operating squadrons, their supporting Air Material Command bases, and the ballistic missiles contractors. Communications channels are made up of transceiver networks backed up by teletype circuits. This system is also tied with AMC's transceiver network and the Air Force administrative teletype, AIRCOMNET.

MECHANICAL DIGESTION TRACT

The computer will digest data from operational units, then pass the information on to the weapons system storage site, or contractors, as indicated by the IBM's instructions. An airlift then speeds parts to launchers.

More precise control over inventory is expected when the center swings into full operation. The ballistics missile manager can reduce waste that results when overstocked parts become obsolete. He can also plan better work schedules for maintenance and supply personnel.

Norton's 705 computer can add or subtract two 5-digit figures in 120 millionths sec and make logical decisions. The unit will handle 30 magnetic tapes, each 2400 ft long.

Defense Dept. Roadblocking Madison Ave.

WASHINGTON—The Defense Dept. has cracked down on advertising costs charged to the Government by defense contractors when they recruit scientists and engineers.

Up to now, contractors were allowed to pass along "reasonable" costs—an extremely vague policy severely criticized by Congress. The new policy sets no precise rule, but it does insist that contractor claims be studied on a case-by-case basis.

For this, it gives specific guide lines to determine "reasonableness" of recruitment advertising expenses: The contractor must maintain "effective budget and administrative controls" over such expenditures; he must maintain a work force in line with his order backlog—not build up large technical staffs while waiting for new business; employe turnover rates must not be questionable; salaries and fringe benefits for new employes must not be excessive; there should be no "violation of recruiting ethics"—that is, there should be no pirating of personnel from other contractors.

Gas Turbines—Their Design Future

• Beyond the aircraft field, the small gas turbine has found a host of applications that promise a big future.

• Automotive applications considered the biggest field . . . Ford Motor Company's newly developed, low-cost turbine wheel a real breakthrough, see page 29.

• Expensive development programs force many aircraft gas turbine manufacturers to hunt other uses for an aircraft-type engine.

The Titan . . .
Solar Aircraft Co.'s latest addition to its gas turbine family weighs 50 lb. and will produce 55 hp at sea level at 100F. At lower temperatures, output is jumped to 70 hp. Only 21 in. long and 12 in. in dia., a single shaft version will be used on one-man helicopters, while a split shaft version will be used on flying platforms. The crank is for hand starting. Solar also builds other 50, 500, and 1000 hp gas turbines.

NEW YORK—Gas turbines are going places. Mention them, and many people immediately associate them with the supersonic aircraft that establish new speed records. But the turbines are now springing up in all sizes for a variety of applications—boats, trucks, cars, earth-moving equipment, small executive aircraft, portable power generators, portable pumping units, and air and gas compressors, to mention a few.

The gas turbine engine gained its fame, of course, in military aircraft, and in a relatively short time since its first flight in Aug. 1939, it has supplanted piston engines in combat planes. It is expected to do the same in commercial aviation by 1965. But by this time, particularly in the small (below 2,000 shp) gas turbine field, it will have gobbled up a large share of the markets for the above listed products, and undoubtedly a few more.

Dr. Helmut Schelp, assistant chief engineer for the AiResearch Mfg. Co. of Pheonix, Ariz., a Div. of Garrett Corp., says, "Military necessity has so accelerated gas turbine development that its utilization curve is zooming to a peak at a rate unequalled by any other power plant."

AiResearch, which considers itself the world's largest manufacturer of small gas turbines, is already turning out a variety of turbine-powered compressors, engine starters, generators and other auxiliary power units for airborne and ground support use in military and commercial aircraft. The company foresees a widespread use of related equipment in industry. A big advantage is that a gas turbine can deliver shaft horsepower to any variety of generators, hydraulic pumps, or high-pressure compressors, plus providing large quantities of low-pressure air and exhaust heat.

Because initial applications were in aircraft, the first 10 years of gas turbine development have stressed reliability, high power output and light weight. Production has not been overlooked, but fuel economy was given less attention. Dr. Schelp reports that his company's turbines have passed the 1000-hours-between-overhauls goal with complete generator and compressor systems going well beyong this point. But he feels that a 5000-hour figure is a minimum for commercial users. Operation at higher combustion temperatures and with higher pressure ratios will give performance closer to the basic gas turbine cycle, theoretically more efficient than reciprocating engine cycle.

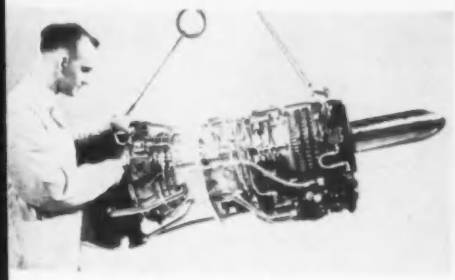
Metals with greater high-temperature resistance will help, since a 2400° nozzle box temperature in a turbine would give a specific fuel consumption comparable with that obtained by 3000° combustion temperature in a reciprocating engine. Cooling of the blades is another possibility. These steps will permit reducing specific fuel consumption without corresponding weight increases. Dollar-per-horsepower costs will come down with higher production, and should drop the cost of gas turbine below gasoline or diesel engine prices. However, because of the impossibility of scaling down tolerances, and the impracticability of scaling down accessories, Dr. Schelp feels that 30 hp is about the smallest practical size for efficiency and producability at the present time.

AUTOMOTIVE FUTURE

Many people think that the real future of the gas turbine is on the road, and for this it must be produced competitively with present gasoline piston engines. (Ford Motor Co.'s latest development looks like a big step in this direction, see page 29). Automotive people figure that the economical low limit for such an engine will be 200 bhp. For instance, a 300-hp gas turbine fits more than comfortably in the space now required for a reciprocating engine. High exhaust temperature of the early turbines has been reduced to that of present cars with the addition of a heat exchanger, which has improved engine efficiency. The real problem is inlet air silencing, but this requires only engineering development, rather than a new breakthrough.

Acceleration of the vehicle from idling is still a problem. It takes from 5 to 7 sec. before the car will move after the accelerator has been depressed. This problem is minor as far as trucks are concerned.

A unique safety requirement is that turbine disks must not split in operation. When an engine failure occurs, it must be the blades that are torn off the wheel; but the wheel itself must remain intact. Turbine covers



The T58 . . .
made by General Electric, is a 1050 shp model used in several helicopters, and is now being suggested for commercial use where its advantages of light weight and high hp can be used to good advantage. Power take-off which is from a free turbine wheel shaft, is possible in any one of three positions either forward or aft.

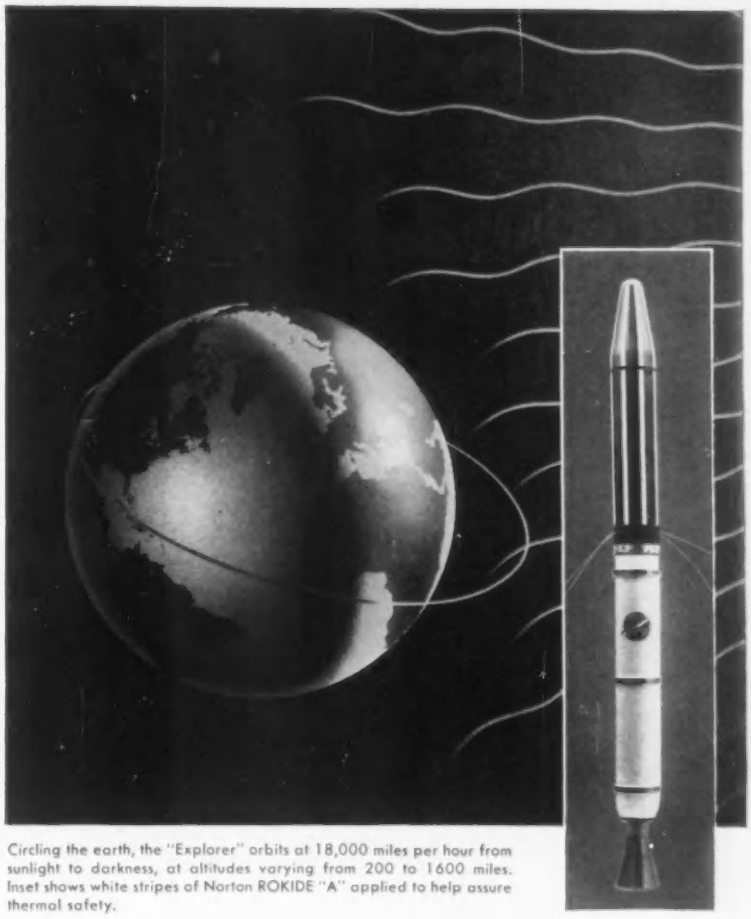
can be designed to contain the broken blades, but not a split disk.

NO TRANSMISSION

As truck engines increase in size, the gas turbine becomes more practical, since it operates well without the complicated transmissions now required in heavy trucks. Efficiency at high loads is a point in its favor.

A recent survey by the American Trucking Association indicates that the trucking industry's expenditures accounted for 7.5% of the gross national product in 1952 and that this will increase to 10.2% in 1975. Today there are 11 million commercial vehicles in use in this country, and by 1975 it is estimated this figure will increase to 17 million. With the expanding highway construction pro-

Researching a crawler . . .
tractor with a Boeing 502-10C model gas turbine is being done at the Springfield, Ill., proving ground of Allis-Chalmers Mfg. Co. Net horsepower developed by the turbine is said to equal that of the diesel engine formerly used. External appearance of the P-91 tractor differs little from the current model. Noise level is equal to that of the diesel unit, but of a different pitch



Circling the earth, the "Explorer" orbits at 18,000 miles per hour from sunlight to darkness, at altitudes varying from 200 to 1600 miles. Inset shows white stripes of Norton ROKIDE "A" applied to help assure thermal safety.

Hotter than fire . . . colder than ice

ROKIDE coating protects the "Explorer" through temperatures from 600°F to 150° below zero.*

Completing its orbit every 118 minutes, the "Explorer" speeds between blazing daylight and black night every hour, through temperatures ranging from 600°F to 150°F below zero.

The resultant thermal risks, especially to instruments, are enormous. By striping the satellite's nose cone and instrument section with ROKIDE "A" aluminum oxide spray coating, Jet Propulsion Laboratory scientists were able to maintain a safe internal temperature range.

ROKIDE "A", "ZS" and "Z" coatings are hard, crystalline refractory oxides. These Norton developments have high resistance to excessive heat, abrasion and corrosion that has proved valuable not only in reaction motors and AEC projects, but to general industry..... ..... in applications involving electrical insulation, electronics, bearing surfaces, erosion resistance, chemical barriers, material upgrading, surface catalyst activity and altering emissivity and characteristics of surfaces.

Facilities for applying ROKIDE coatings are maintained at Norton Company, Worcester, Mass., and at its plant at 2555 Lafayette Street, Santa Clara, Cal. For the latest ROKIDE Bulletin write to NORTON COMPANY, 732 New Bond Street, Worcester 6, Massachusetts.

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NEW PRODUCTS
Making better products... to make your products better

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NORTON PRODUCTS Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals
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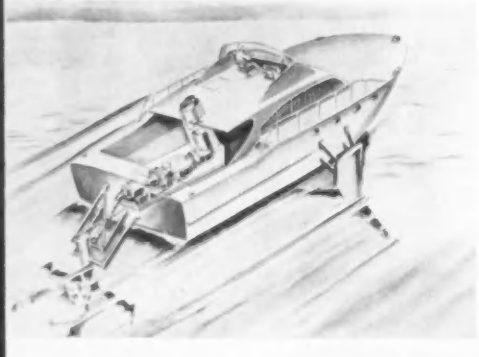
gram, truck transportation can be expected to change to larger and heavier units for moving greater loads at higher speeds. Engines of two to three times the present power will be required, thus putting the squeeze on the reciprocating engine, which at such horsepowers would be large and heavy. Several General Motors engineers say that the situation in trucking is comparable with that in aircraft several years ago when significant increases in horsepower were required. The answer: gas turbines.

Bus service on superhighways of the future is also considering gas turbine power. However, such a bus would be designed strictly for highway operation from terminals close by. Design for handling in heavy traffic is not being considered.

The big off-the-road earth moving equipment field (*PE*—Dec. 23, '57, p. 80) has great gas turbine potential. For example: crawler and wheel-type tractors; self-loading equipment; power shovels. Here, inducements would be smooth power application, high degree of dirt tolerance, and less altitude sensitivity.

These are some advantages of gas turbines for automotive use, cited by the auto makers: fewer spare parts, since there are only about one-third the total number of parts and few wearing and rubbing surfaces compared with the piston engine; easier servicing and overhaul, because of fewer critical tolerances, simpler parts.

Hydrofoil speedster . . .
showing artist's conception how a gas turbine unit might be installed. Miami Ship-Building Corp., under a Navy Bureau of Ships contract, is testing a similar type craft with a Lycoming, Div. of AVCO Mfg. Corp. T53 gas turbine rated at 925 shp. The T53 is presently being used in two military helicopters.



Fuels are no problem. While it is true that leaded gasoline corrodes the turbine in short order, unleaded gasoline, liquid petroleum gas and other fuels are satisfactory. A possibility is diesel fuel, but this would require a second fuel for starting purposes.

OTHER APPLICATIONS

General Electric's Small Aircraft Engine Dept. at Lynn, Mass., has a pint-size engine that can turn out 1050 shp. Designed for the Navy Bureau of Aeronautics for helicopter use, the T58 engine has an over all length of 55 in., a max flange dia of 15 in., and a weight without reduction gear of 267 lb, (see page 23). Specific fuel consumption is set at 0.654 lb/hr/hp.

Some of the fields which GE feels can be tapped for this engine are marine: that is, small craft in the 35 ft to 100 ft size, some with hydrofoil design. Other companies, for example Solar Aircraft and Lycoming, are experimenting in this field also, (see below, left). Solar Aircraft, in the gas turbine field since the end of World War II, has produced many gas turbines in the 500-hp and 1000-hp range, many for marine use. A 50-hp unit is a portable unit with wide application.

Looking for uses where a gas turbine's high power-output-to-weight ratio is particularly effective, GE is checking into oil well service equipment, such as pumping units for the fracturing process. Large trailer trucks carrying two 600-hp diesel engines are now used. GE says that two of its T58 engines can be mounted on a much smaller truck with a much greater increase in output and decrease in truck weight.

The military has its eye on the gas turbine for some of its marine applications, like landing and assault boats, and high-speed personnel craft. An Army spokesman says that, within the next two to four years, use of the gas turbine will outpace the piston engines in such tactical equipment where weight is important. He amplified this statement to include tanks and vehicles as well as amphibious applications. Other military uses are de-icing and smoke generating (smoke screen) equipment.

DEVELOPMENT PROGRAMS EXPENSIVE

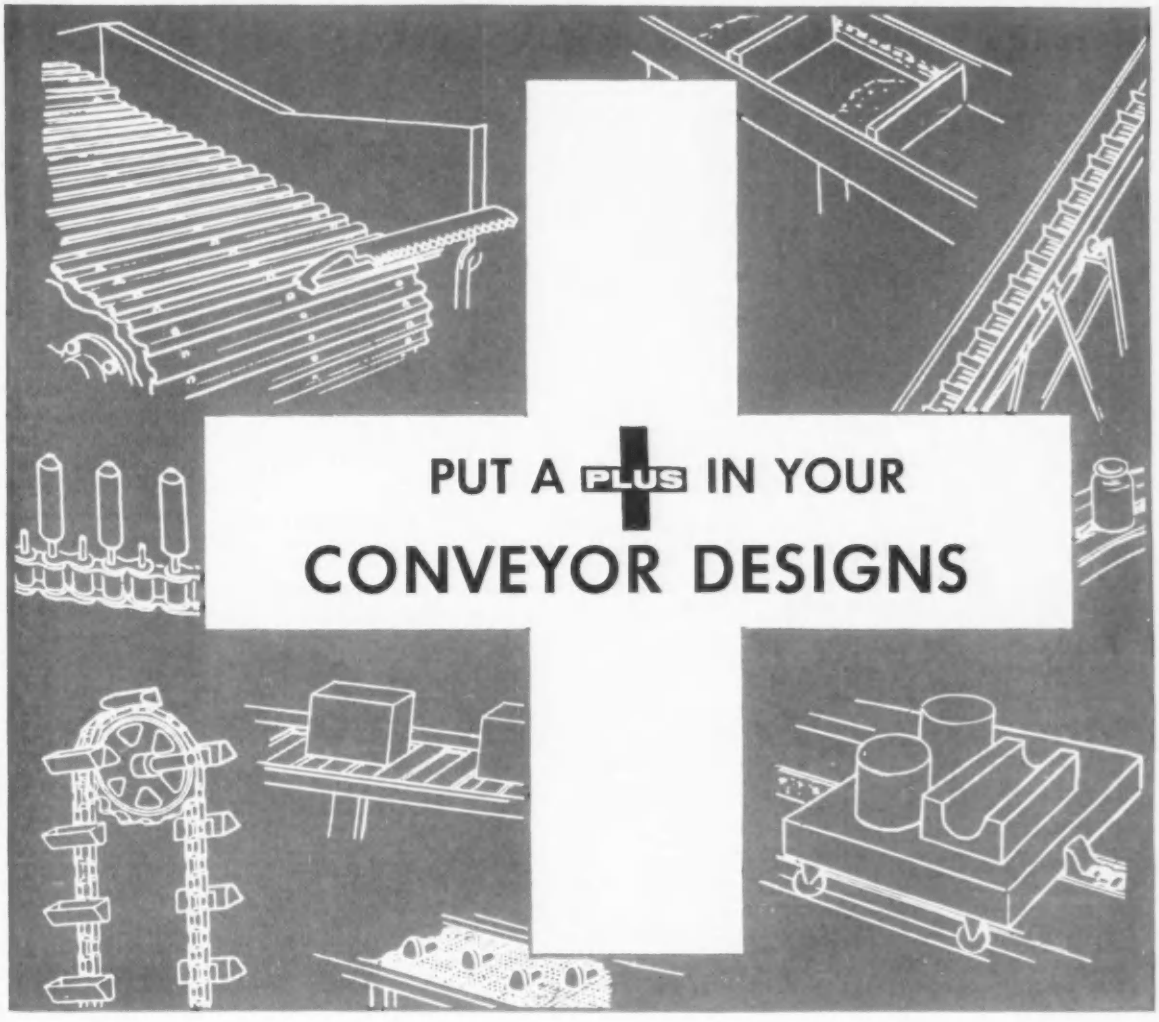
Lycoming Div. of AVCO says, "It is a generally accepted view that the costs of developing and manufacturing gas turbines for the variety of fields previously mentioned, to be competitive with existing piston engines today, are prohibitive. A reasonable approach to this problem is to take advantage of a well-established aircraft turbine program, thereby eliminating the more expensive features of basic engine development. Experience with aircraft gas turbines is proving to be a vital factor in the development of gas turbines for the marine and industrial markets. Considering gas turbines in general, good fuel consumption is desirable, but low cost, reliability and longevity are the major features that must be provided."

General Electric's Small Aircraft Engine Dept. has the same concept in searching for other uses for its T 58 engine. It feels that a problem exists of educating the nonaircraft engine user to an aircraft engine, and a non-gas turbine user to a gas turbine. This involves maintenance of an engine the users feel they don't know anything about.

The latter is an important point being considered by the automotive companies before they decide to switch completely to gas turbines in cars. A nationwide network of service stations educated to working on the piston engine would have to be converted to servicing a completely different kind of power plant.

MANUFACTURING COSTS

For the most part, the turbine engine consists of simple castings and stampings that require no new manufacturing methods. Even so, manufacturing costs still remain high because engines of this type have not been built in quantity with automotive production techniques. Adding to costs are the substantial quantities of special high-temperature-resistant alloys are needed. These materials are difficult to machine, weld and fabricate. When such thin-gage material is used to reduce weight, welding often causes distortion and cracking. In addition many parts, blades for example, are small, and must be worked to close tolerances because of the shape of the airfoil. Present gas turbine production costs per horsepower are roughly twice those of piston engines. Such costs will have to be met if the turbine market is to meet future growth expectations.



In your conveyor designs, you plan a *plus* that makes your equipment have sales appeal for your customers. The plus may be superior performance... more dependable operation... lower first or operating costs. But how about the components you specify?

Do they have the same *plus* values... do they fulfill the over-all objective of your design? Can you get a *plus* in the components that will live up to your design demands... give you the extra customer appeal you want?

At CHAIN Belt we put that *plus* into all our products: chains, bearings, belt idlers, pulleys, sprockets and couplings. And we put a *plus* into our service. Your CHAIN Belt man is trained to help you in your component selection... he has a complete line and can recommend the *right* product *without prejudice*. He has no "axe to grind" in his specification assistance.

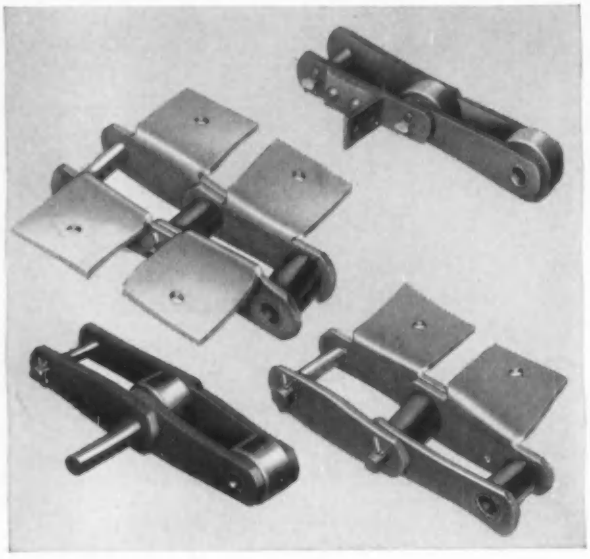
The following pages give you a quick picture of the *plus* values in CHAIN Belt that can help put the *plus* into your designs.

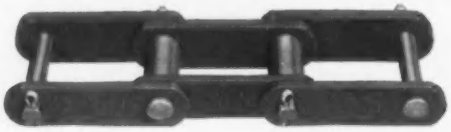
CHAIN BELT

QUICKENS THE PACE OF PROGRESS

TURN PAGE

the PLUS values in...REX Chabelco® Chains

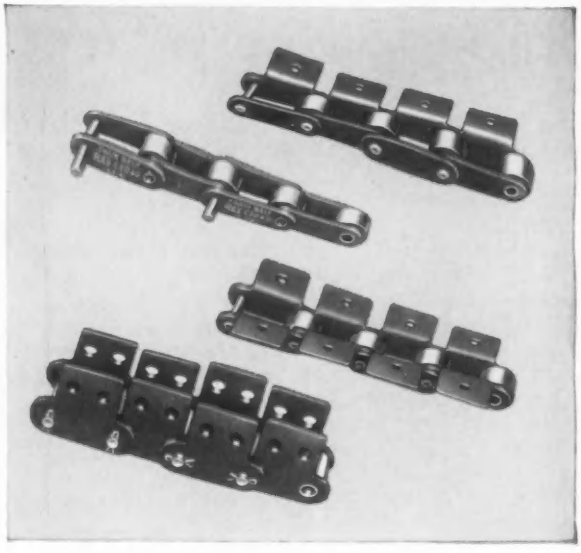




For conveyor service such as bottle washers, carton and package conveyors, or ovens, Rex Chabelco Steel Chains give you the extra strength...extra stamina...that means exceptionally high working-load ratings. These are "work-horse" chains, with carefully heat-treated parts to provide the hard surfaces for extra wear resistance...but with an inner ductility to provide maximum resistance to shock loads. Because of their longer pitch, they have fewer parts per foot of chain...an important cost-saving advantage. And they operate over cast-tooth sprockets...another economy advantage. A complete line of attachments is available.

the PLUS values in...REX Double Pitch Roller Chains

For the higher speed conveyors or where precise timing is required, the plus values in Rex Double Pitch Roller Chains make them right for your conveyor designs. Since the primary requirement of a conveyor chain is the ability to resist a tensile load, correct material selection and proper heat treatment are essential design requirements to put a plus value into the chain. In Rex Roller Chains, material for each chain part is carefully selected for maximum strength and wear resistance. Then parts are heat-treated in atmospherically controlled furnaces. Controlled atmosphere eliminates elements that cause chemical action on the parts...prevents loss of carbon content ...produces parts of maximum strength and wear resistance.



For complete information on Rex Chabelco and Roller Chains, send for Catalog No. 610.

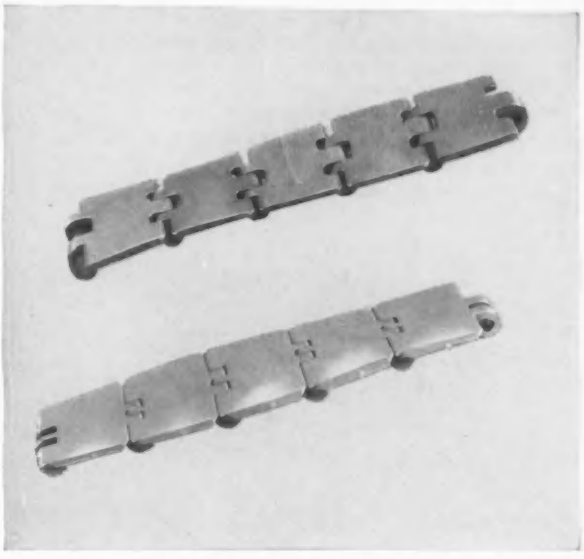
CHAIN BELT

4715 W. Greenfield Ave., Milwaukee 1, Wis.

CHABELCO CHAINS • ROLLER CHAINS • SPROCKETS • COUPLINGS • DOUBLE PITCH ROLLER CHAINS

the PLUS values in...REX TableTop® Chains

For handling bottles, cans, jars, cartons, small parts and packages, Rex TableTop Chains provide unequaled *plus* advantages. Available in either steel or nylon, these chains provide a level, flat carrying surface. Only two parts...top plates and pins...make TableTop simplicity itself, providing a new concept in low-cost conveying.



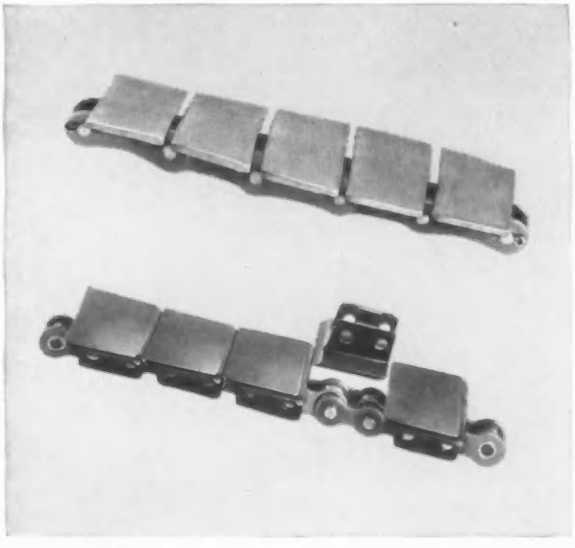
STEEL TABLETOP

Available in case-hardened or stainless steel. Provides a level surface with practically no gap between links... with hinge-type interlacing of links.

NYLON TABLETOP

Has no gap between links. No lubrication is required. Light weight cuts horsepower requirements...assures low operating costs.

the PLUS values in...REX PlateTop® Chains



Where higher operating speeds, heavier loads or exceptionally long centers make TableTop less suitable, Rex PlateTop Chains have *plus* values for your conveyor requirements.

STEEL PLATETOP

The steel chain has steel top plates induction-welded to a double pitch roller chain. Induction-welded top plates eliminate possibility of plates working loose or wobbling.

NYLON PLATETOP

The Nylon PlateTop Chain has nylon top plates snapped onto extended pins of a ¼-inch-pitch roller chain. Chain can be run without lubrication if longest life is not essential.

For complete data on "Tops" chains, send for your copy of Bulletin 56-60.

CHAIN BELT

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TURN PAGE

LEAF CHAINS • CAST CHAINS • DROP FORGED CHAINS • ELEVATOR BUCKETS • ROLLER BEARINGS

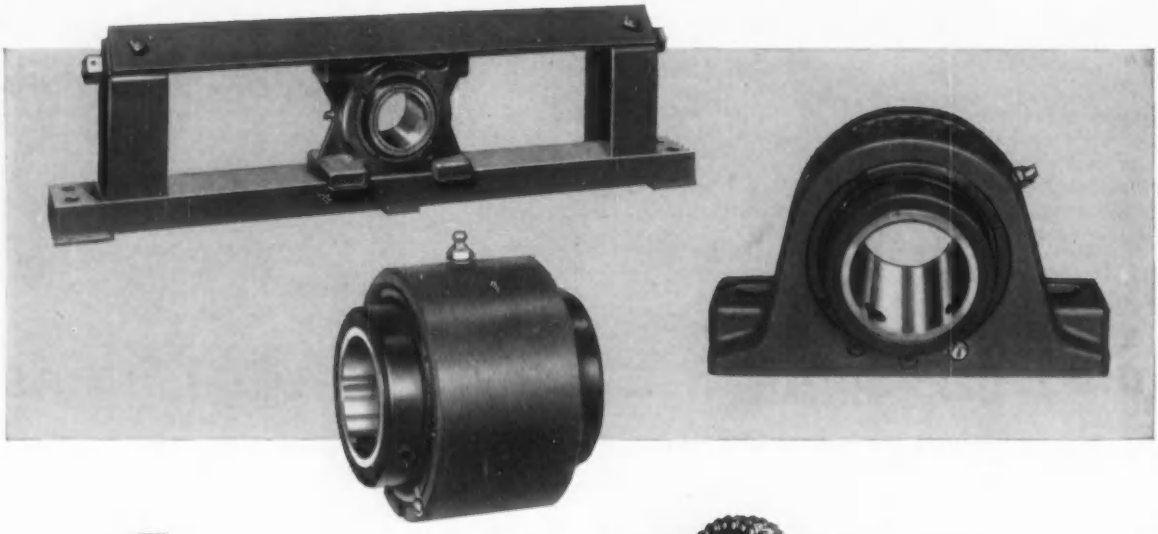
the PLUS values in...Shafer® Bearings

Pillow blocks, take-ups, cartridge units... whatever your conveyor design calls for... you build extra value into your products with the *plus* values in Shafer Bearings.

Take capacity, for example. Shafer Roller Bearings will deliver their rated load capacity for five years and more. Compare this with bearings which will carry that same load for less than a year.

Take self-alignment, an important feature of conveyor operation. Shafer Bearings provide for 3° total misalignment... provide compensation for shaft deflection, shock loads, misalignment.

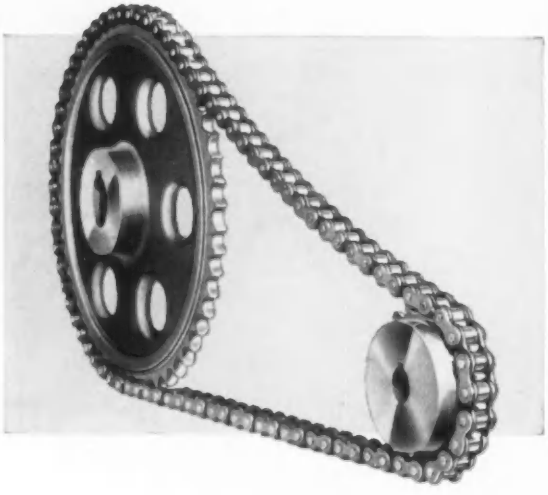
The famous Shafer design that combines the low rolling friction of a ball with the high load-carrying capacity of a roller is your best choice to put a plus into your conveyor design... for load capacity... for life... for overall economy.



the PLUS values in...

Rex Roller Chains

Rex Roller Chains provide the *plus* quality that assures smooth, dependable power transmission. All pin link holes have designed-in beneficial stresses that assure maximum fatigue strength. Bushing seams are properly positioned so that the impact loads are distributed over the full bearing area of the bushing. Oil slots in the bushings assure complete penetration of lubricant to all working parts. These and many other *plus* features add the extra fatigue strength and wear life to Rex Roller Chains.



For complete information on Shafer Bearings, write for Bulletin No. 55... for data on Rex Roller Chains, send for Bulletin No. 5725.

CHAIN BELT

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Big Step Closer to Auto Gas Turbine

DETROIT—The automotive gas turbine is a lengthy stride closer to highway usefulness as the result of a development by Ford Motor Co. It has reduced cost of a turbine wheel from about $4,000 to less than $100, plus cost of blades.

This is for small wheels of approximately the size that would be for automotive use. Larger wheels (of the size called for in jet aircraft gas turbines) which now cost around $9,000, will benefit from a proportionate cost reduction.

The process consists of extruding the hub of the wheel around the roots of the blades. All metals, from low carbon steels to "exotic" alloys can be formed by the process.

The blades are positioned in a ring so that airfoils are in the exact position they will occupy in the finished wheel. Kirksite, melting at 700 F, is then poured around the airfoils and allowed to solidify. This keeps the blades in their relative positions through the subsequent operation.

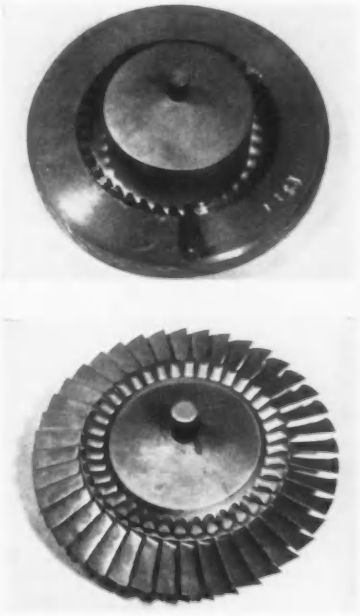
The solidified ring of Kirksite-embedded blades then goes into a die, and the roots are heated to a temperature that varies with the blade's alloy. A hot billet is placed over the empty center of the ring and extruded over, around and under the blade roots. Minor machining is necessary to remove excess metal from the turbine wheel faces.

Temperatures of blade roots and of billet have not been revealed, but they are reported to be much higher than had previously been thought practical —approaching the critical temperature of the metal. Temperature of the blade roots allows them to be shrink-fitted in the extruded hub without checking or internal cracking.

No fusion occurs between the blade roots and the hub material, the bond being purely mechanical. Variations in the relative temperatures of the blade roots and billet produce various types of fit, so that the tip of the blade might be free to move one or two degrees, a requirement in some turbine-wheel designs.

HIGH EFFICIENCY TURBINES

To obtain good efficiency from the fuel it is expected that gas turbines for automobile use will operate at temperatures even higher than those of aircraft types. Blade temperatures are expected to be 1500 F or higher, with inlet gas temperatures that may reach 2200 F. This precludes any possibility of downgrading hub metals.



Before and after . . . of Ford Motor Co.'s new low cost method of making a gas turbine wheel. Above blades have been positioned and sealed in Kirksite with the root ends exposed. Heated billet in the center is extruded over and around the blade roots. Finished turbine wheel, (below) is shown with Kirksite removed from between airfoil blades. Only step remaining is to remove excess metal from the hub.

ECONOMY OF DESIGN

One advantage of the new technique is that all of the material is put to work; none is lost through machining slots in the hub to house the fir-tree shaped blade roots. Cost of machining of fine tolerances also is eliminated. New root design is expected as a result, probably approaching the shape of an elongated bulb.

Analysis of the hub-blade interface shows that no voids are left when the extrusion operation is performed at proper temperatures and in a press of adequate force. For example, 10,000 tons is required for a J57 engine wheel. Representatives of the Steel Improvement and Forge Co., Cleveland, who have been involved in development work on the new process, say the process can be fully automated when production requirements are sufficiently large to warrant it.

INCREASED STRENGTH

As the hub flows about the blade roots, metallic fibers follow the contour of the roots. They are not cut as was previously necessary in machining the root slots. This increases strength of the hub—giving all the advantages of a forging. Simplifications of root design permits easier flow of the hub metal, further increasing the strength.

Because the blade root is held in place by a mechanical bond, a defective or broken blade can be forced out of the completed wheel and replaced easily, cutting down on the number of rejected wheels and permitting repair of wheels that have blades broken in operation.

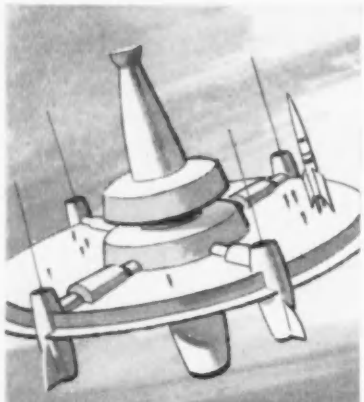
The process is beyond the development stage, and inquiries from manufacturers in such fields as aircraft and missiles are being quoted on the basis of design, with a performance guarantee. This is expected to effect a considerable reduction in the cost of many defense projects.

Infrared 'Eye' Warns of Gas Attack

EDGEWOOD, MD.—The Army has successfully field-tested and integrated as standard equipment an infrared "eye" to warn troops in the field about an enemy gas attack.

A tiny amount of contaminant can be as distant as a quarter of a mile away. When it crosses the infrared beam, this "eye" flashes a warning light and sounds a horn, warning soldiers to don gas masks.

New device is said to be so sensitive it can detect, in an average-size living room, the evaporation of a droplet the size of a pinhead. The "eye" is slated for use by infantry combat teams.



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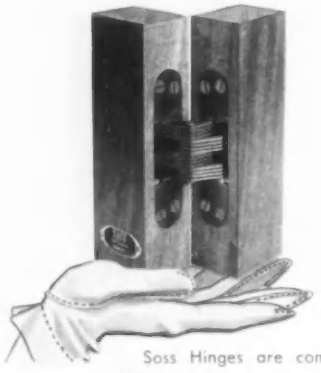
SOSS INVISIBLE HINGES

"The Hinge That Hides Itself"

Soss Invisible Hinges enable you to do a better job whether you're designing a rocket to the moon or a new typewriter.

NO PROTRUDING HINGE BUTT



Soss Hinges are completely hidden from view when doors or lids are closed. They are the only hinge that creates the flush, smooth streamlined surfaces so necessary for modern design. Unique Soss Hinges are available in a wide size range to meet every requirement.

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Fairey Claims Lead in VTO Aircraft

LONDON—Fairey's vertical take-off airliner, the Rotodyne, has achieved transition from helicopter to autogyro flight, the company reports. In recent tests from White Waltham Airfield near Maidenhead, Berkshire, the aircraft climbed to 4,000 ft as a 'copter. Power to the rotor was then closed down and transferred to the two forward-facing propellers.

After a period of straight, level and steady flight with the rotor autorotating, the Rotodyne reversed transition procedure and made a vertical landing.

Since its first flight, Nov. 6 last year, the Rotodyne has made 71 flights. Five months of development were required to achieve transfer of power from the rotor to the forward-facing propellers.

"This successful transition puts the Rotodyne far ahead of any other helicopter or vertical take-off aircraft in the world," Fairey says.

Fairey has a contract to develop two prototypes from VTO specifications drawn up by British Overseas Airways. The aircraft now flying can carry up to 40 passengers. The second, in an advanced stage of construction, has a larger fuselage to accommodate 48 passengers or 4½ tons of freight over ranges up to 400 mi at cruising speed of 185 mph.

Lead, Zinc Industries Chip in for Research

ST. LOUIS, MO.—The American Zinc Institute (AZI) and the Lead Industries Association (LIA), are jointly assessing member companies to provide a research budget of $50,000 for next 5 years (*PE—Jan. 6, '58, p. 35*).

This modest sum is supported by increased research on the part of member companies. Present actively-sponsored research at Battelle Memorial Institute includes AZI program on finishes for zinc diecastings, LIA survey of promising applications for lead.

Meanwhile, Simon D. Strauss, vice-president of the American Smelting and Refining Co. and president of AZI, estimates that the zinc industry last year spent only ½% of its gross for sales and promotion—the lowest of all metal industries.

8 tons of power!

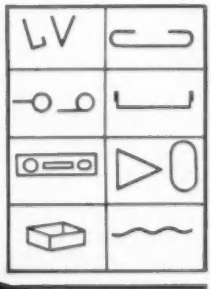
For . . .
Bending
Curling
Box Forming
Corrugating
Punching
Blanking
Hemming
Flattening

NEW DI-ACRO* PRESS BRAKE

Eliminate tie-up of a large press brake on short-run production jobs with the new Di-Acro Press Brake. It's quickly set up for experimental engineering, too. Hand operated—ample power is provided for average use by a simple cam lever mechanism, plus a power multiplying ratchet drive for heavy forming jobs.

New Di-Acro Press Brake forms 16 gauge mild sheet steel across the full 24" forming width, 10 gauge mild sheet steel across a 12" width as well as other ductile materials. Available with standard dies and specials—both are interchangeable with other press brakes.

Diagrams below illustrate typical operations with a Di-Acro Press Brake and its remarkable versatility.



Write for free Press Brake literature
Send for 32 page catalog . . . contains complete information on Di-Acro hand and power operated Benders, Brakes, Notchers, Punch Presses, Rod Parters, Rollers, Shears, Spring Winders.

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Bits and Pieces

"World's largest" power metal press—capable of exerting 6,000,000-lb pressure—installed at Chrysler's Amplex Div. in Detroit. . . . A mechanical homing instinct capable of guiding US missile warheads to targets that are continents away without aid of radar, ground control; magnetic compass, sun or stars, etc. is called SPIRE and developed by Monsanto Chemical in St. Louis, Mo. . . . Shell Development Co. reports possibility of creating a jet fuel that can effectively resist high doses of gamma radiation—such a fuel is necessary to power auxiliary engines of atomic aircraft. . . .

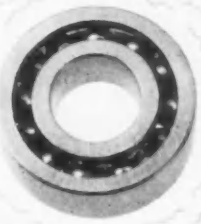
A Dictaphone Time-Master is enabled by transistors to provide instant start-up, claims to eliminate costly work interruptions for amplifier repairs. A Russian-English glossary of approximately 30,000 aeronautical and miscellaneous terms has been prepared by the Air Force and published by the Office of Technical Services, US Dept. of Commerce. Glossary places emphasis on compound terms, always difficult to translate into idiomatically accurate interpretations.

By replacing an assembly of primarily metal composition with a slide molded of filled nylon, Westinghouse Electric's redesign of a lockstop for an oven door yielded a 10% to 20% saving in material costs in addition to assembly labor savings. . . . Largest aluminum heat-treat furnace in the aircraft industry has gone into operation at San Diego to process parts for the Convair 880 jet transport. Oven handles beams up to 40 ft long from which the aircraft's belt frames are formed. Usable interior area is 41 ft long, 8 ft wide, 8 ft high. . . .

Vidmar of New York reports development of a line of metal storage cabinets, designed around modular concept, guaranteed to increase storage efficiency and capacity of any industrial plant up to 50% over present arrangements.

Special locking device permits locking all drawers in bank of cabinets with turn of a handle, also allows for complete interchangeability of component units.

Operates at 1100° F.!



This 7⅝"-OD bearing carries a 150-lb. load with a slow oscillatory motion at temperatures to 1100° F, while subjected to vibration and severe corrosion conditions. Other special high-temperature bearings by ITI meet even tougher requirements.

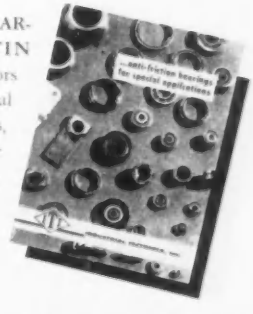
Used in jet engine components, this special bearing operates at temperatures from 600° to 1100° F, under severe oxidation and corrosion conditions, for a minimum service life of 300 hours. Balls and races are special cobalt-chromium-nickel alloy for hot hardness and durability.

As with all high-temperature bearings, success depends largely on careful attention to internal geometry and other minute detail, based on experience and bearing engineering know-how. At high temperatures, available materials that have the required hardness, wear and corrosion properties are frequently marginal with regard to load-carrying and fatigue characteristics, especially when operating temperatures exceed ceilings of available lubricants.

We have designed and manufactured high-temperature bearings to meet a wide variety of requirements as to speed, load, temperature and service life.

IF YOU need anti-friction bearings of *special shape, size, heat resistance, corrosion resistance, low torque, ultra precision, non-magnetic properties, or other unusual characteristics,* we can supply them — designed and built to your specific requirements. We invite your inquiries.

NEW 24-PAGE BEARINGS BULLETIN tells about the factors involved in special bearing applications, and describes our work in this field. *Write for Bulletin AFB-2.*



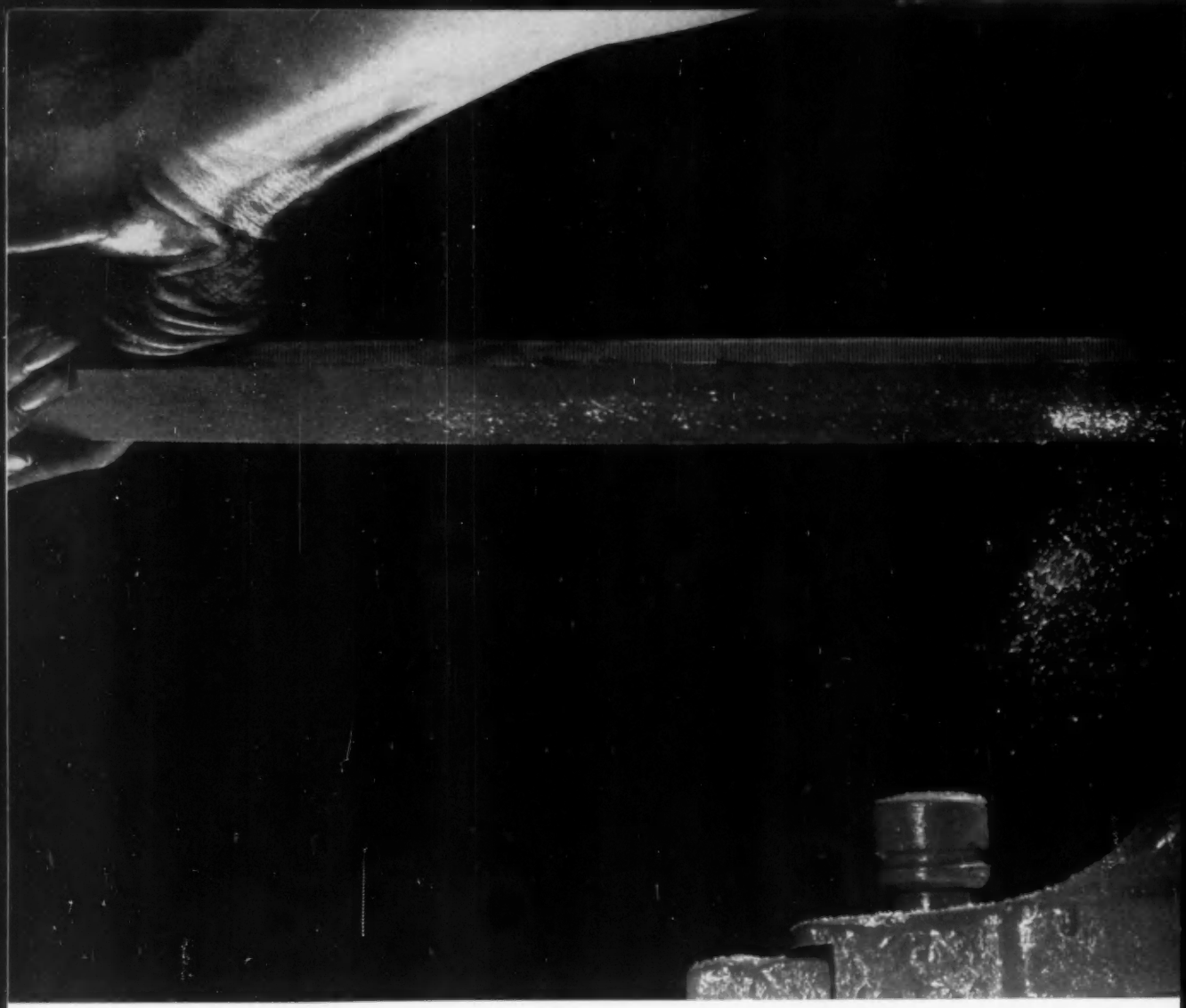
INDUSTRIAL TECTONICS, Inc.

ITI

MANUFACTURERS OF PRECISION BALLS AND BEARINGS

3661 JACKSON RD., ANN ARBOR, MICHIGAN

WESTERN DIVISION PLANT: COMPTON, CALIFORNIA



Wear Resistance is a common problem for designers, even when they're using a durable material like steel. Of course, it is well known that you can increase the abrasion resistance of a given steel when you improve its hardness (and thus, its strength). But when you harden and strengthen a steel so that it will resist wear, you usually run into some complications.

For instance, when we vary the wear resistance of steel, we also vary its *other* properties, and this causes problems for the designer or his metallurgical advisor. Examples: hardness and strength can be developed in various ways—increase the carbon content, add alloying elements, cold work, heat treat. These methods vary in cost, and each has a different effect on hardness, strength, toughness, corrosion resistance, formability and weldability.

There is one steel with the best combination of properties for every design application, and you're almost sure to find it in the vast range of USS Design Steels—whether Carbon, High Strength, Alloy or Stainless Steel. Here is the widest range of steels available, offered by a company that has produced well over a *billion* tons of steel.

Of course, over-design must be avoided as rigorously as under-design, and designers must always walk the prickly path between poor product performance on one hand and high costs on the other. Somewhere among the many USS Design Steels there is the one best steel for the job. The final selection can best be made with the help of a skilled metallurgist—either on your staff or ours.

United States Steel Corporation • American Steel & Wire • Columbia-Geneva Steel • National Tube
Tennessee Coal & Iron • United States Steel Supply • United States Steel Export Company

USS TRADE MARK

United States Steel

STEELS FOR DESIGN

Lower Left—Problem: Blades on this earth dammer wore out after 300 acres. Solution: Blades are now made from USS MAN-TEN Steel, one of several USS HIGH STRENGTH STEELS. Benefit: Blades now last over 1,000 acres for Gunning Mfg. Co., Lansford, N. D.

Lower Middle—Problem. The new "Snow Hawg" rotary snow plow chews into ice, rock and frozen earth and throws it up to 300 feet. A weldable, very strong steel was needed to withstand the punishment. Solution: Vital parts are made from USS "T-1" Constructional Alloy Steel. It can be field-welded, and remains strong and tough down to minus 50°F. Benefit: Outstanding performance, and chute liners of the "Snow Hawg" last two to three times longer.

Lower Right—Problem: Chutes in a coal processing plant wore out prematurely due to abrasive action of coal and corrosion from acid water. Solution: Chutes made from USS Stainless Steel were installed. Benefit: New chutes outlast old ones seven to one. Atkins Coal Company, Frackville, Pa., estimates that a $900 investment in Stainless Steel chutes saved $30,000.

USS, MAN-TEN and "T-1" are registered trademarks of United States Steel

COLOR photography...

a new technical language

Photos, in full color, add a new dimension to test reports and technical descriptions. Here's how they're made and where they've been used.

Take a color shot of your next complex assembly—a piping layout, an electronic chassis, or a test setup. The positive prints that your commercial photofinisher sends (or you process yourself) will be a pleasant surprise and of practical value as well.

Color print production has become simpler. Until 1955 the dye transfer process was the only commercially available system. Here a positive transparency is used to make three records of the amount of red, blue and green light in the scene. The records or "matrices" are then soaked in yellow, magenta and cyan dye and used to transfer the separate layers of color on to dye-transfer print paper by hand or with semi-automatic register techniques.

Newer Method

The Kodak color-negative-to-positive process is far faster and more flexible for small quantities. It is a variation on normal black-and-white techniques. Ten photographic processing solutions are involved in film development. The developed negative is then projected through a conventional enlarger on Type C paper. The exposed paper is then processed in ten solutions, yielding a developed print in 42 minutes. The print may be evaluated for color rendition in as little as 20 minutes after the development process begins.

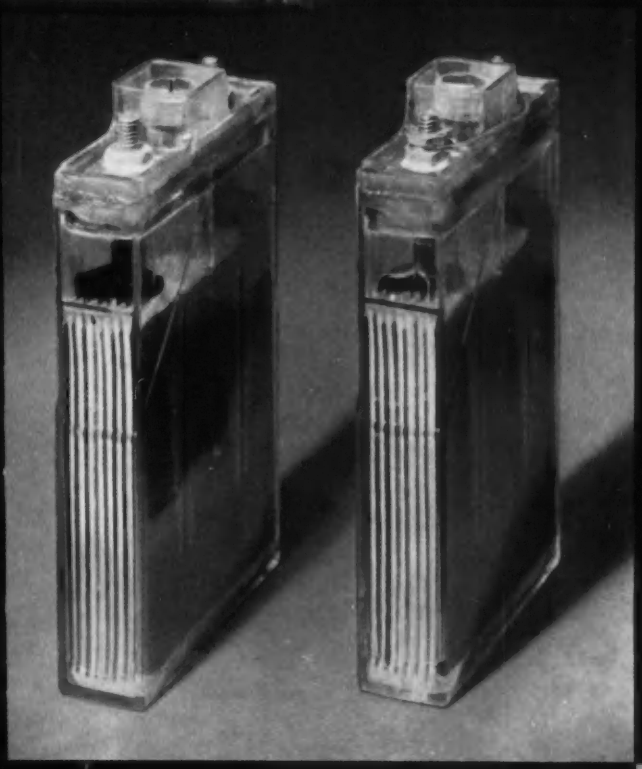
Beauty of the Type C process is that you can get as deeply involved as you like—depending on budget and production requirements. You can try the process on an experimental basis with film, film processing kit, Type C paper, paper processing kit, filter pack and a tungsten light-source enlarger. Or, even more simply, local color processing laboratories will develop your film and supply prints enlarged to order.

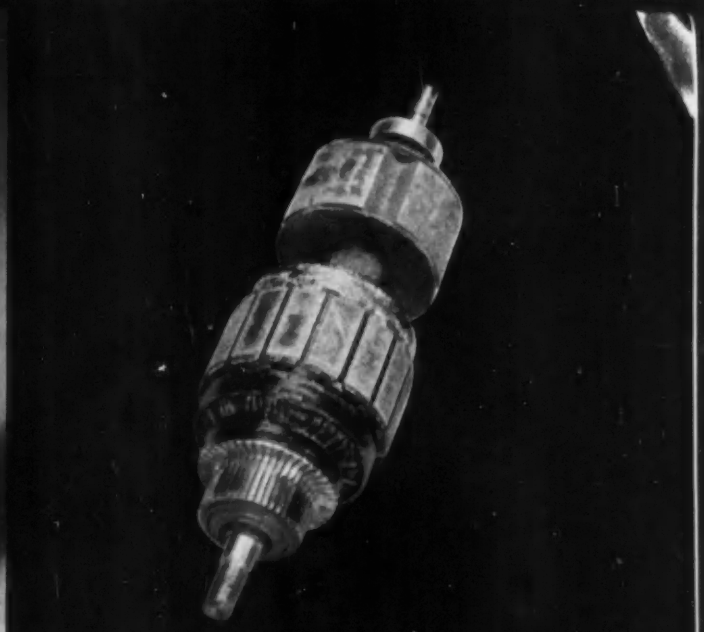
However, any color reproducing medium has limitations which must be understood and anticipated if disappointments are to be avoided.

No color printing process can provide an exact match of the colors in the original scene. However, by using appropriate color compensating filters with the original

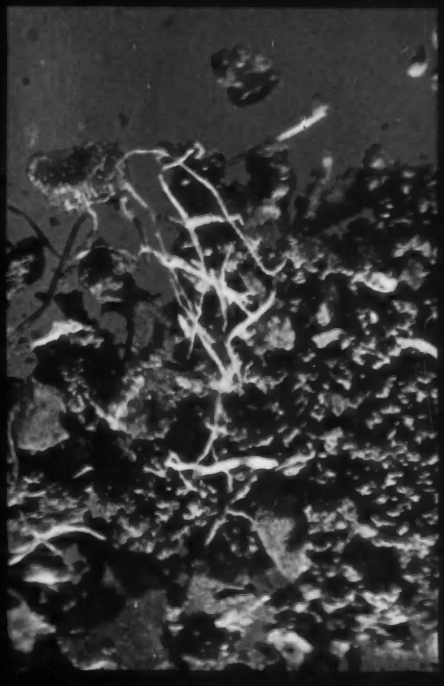
Yellow discoloration in battery . . . shows up clearly here in Sandia Corp. test. Its photography group and extensive materials test laboratory work closely together in making *before, during* and *after* photos to be included in the final report.

Not a scene of underwater plant life . . . but a Gulf Oil photomicrograph of sludge deposit. Scientists can gage with fair accuracy the amount of carbon, lead salts, cellulose filters, carbonaceous matter, iron oxides, clays, etc., contained in the deposit. A written report to the effect that trouble was caused by clay and sand in a lubricant has nowhere near the impact of this print—a 50 X enlargement of sediment in used oil. Oil was dissolved in pentane and filtered; the sediment was then smeared on a glass slide for microscopic examination and to have its picture taken.

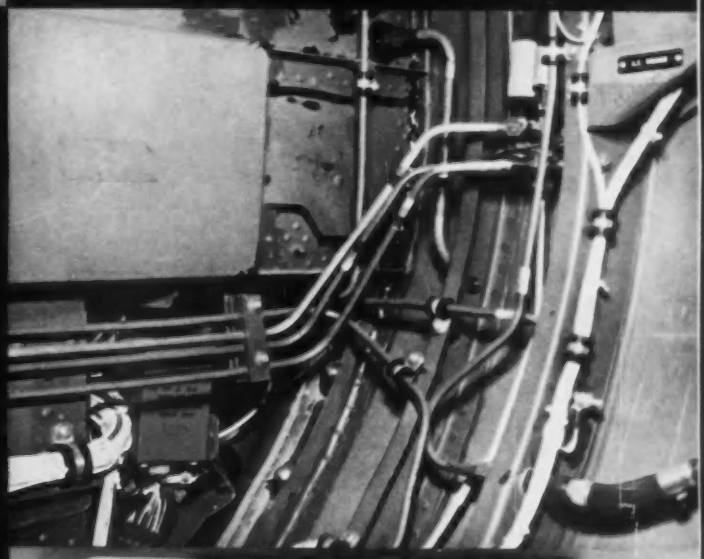


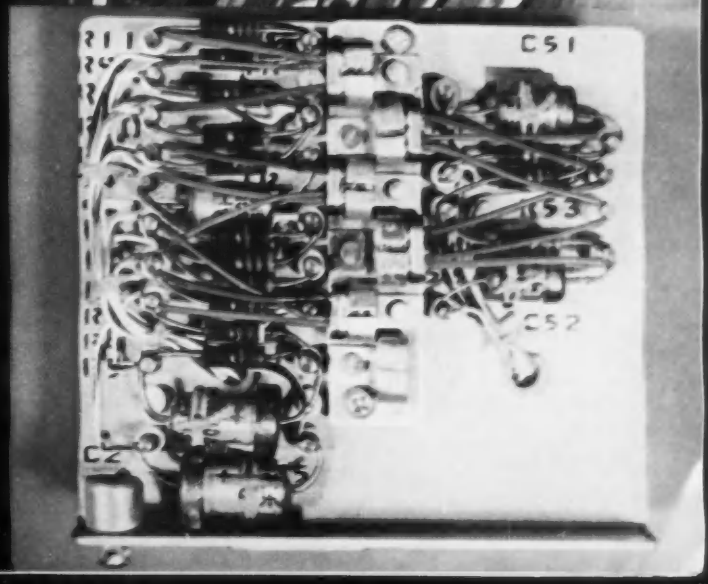


Corrosion on inverter . . .
impedes operation of unit.
Color print helped pinpoint trouble in Sandia Corp. report.

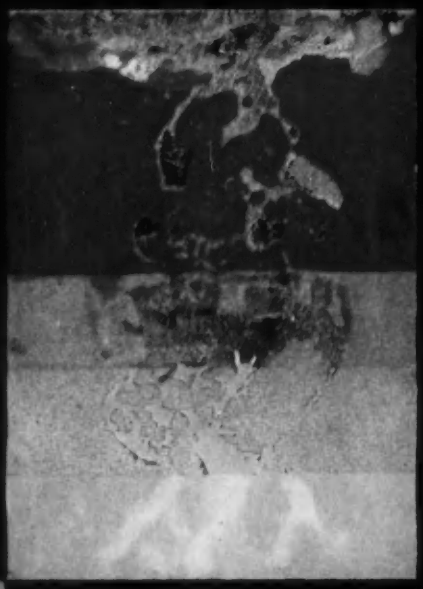


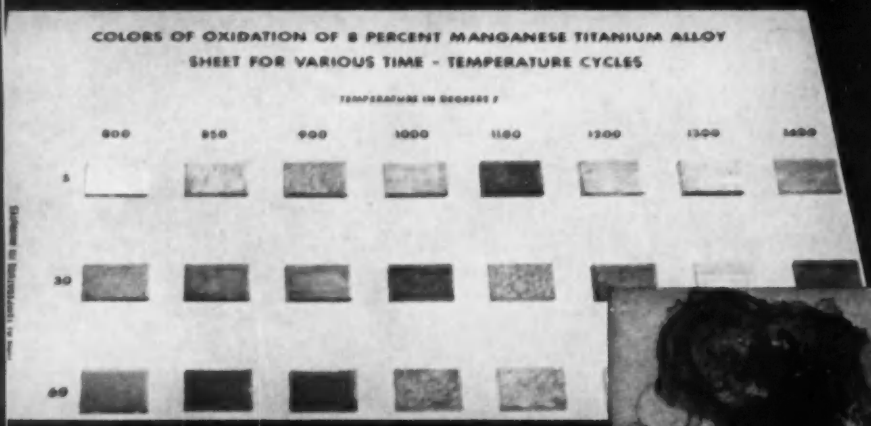
Color-minded assembly photos . . .
can be supplied with instruction books and at each assembly bench. Service engineers use color prints to explain changes to customers, in field training and for customer approval.
(Courtesy: Douglas Aircraft Co., Inc.)





Transmission housing . . .
with varying levels of varnish, resin and tar deposits after experimental lubricant evaluation. (Courtesy: Esso Research and Engineering Co.)





Metal samples . . .
give photo-type reference chart showing colors they turned on exposure to varying temperatures over measured time periods. Comparing with color of a test specimen will indicate conditions it experienced (Courtesy: North American Aviation)

COLOR photography...

a new technical language

negative, color fidelity equalling the best four-color magazine printing may be attained.

Color prints do not "automatically" match, color-for-color, the original subject. Variables in processing the film and print materials may modify the final color somewhat. However, differing colors in the subject will always appear as differing colors on the print—hence in color-coding applications (for example, when a green wire is to be differentiated from a red wire) color prints will work perfectly and with little need for special attention.

When more exact color reproduction is required the photographer and technician must agree on an objective and measurable color-matching goal. A color scale, placed near the object to be photographed, can be used as a color guide and later cropped out of the final print. Similarly the print can be controlled by comparison with the actual test object or with a responsible engineer's idea of what correct color values should be.

Test coupons . . .
show effect of phosphoric acid cleaners on aluminum and printed finishes. Photos provide permanent records; original coupon need no longer be kept available. (Courtesy: Douglas Aircraft Co., Inc.)

Some Applications

Many aircraft firms and oil companies have expanded their photographic facilities to accommodate mass-produced color processing. Gulf Oil Corporation's Refinery Technology Lab handles between 3000 and 5000 prints annually and North American Aviation makes close to 5000 Type C prints each year.

At Gulf, for example, photographic technique may be formal studio work, informal field pictures taken by staff photographers on periodic field sorties from the Laboratory's South Philadelphia headquarters. In this way, on-the-spot photos are made of dismantled engines that have been using experimental Gulf products.

Later, prints are passed along with other data to manufacturing, engineering and marketing personnel. A project engineer working on a new product reads the visual evidence, and has a good idea of how his product stacks up against competitive products.

North American uses color to determine the resistance of metals to a variety of environmental test conditions. Test "coupons" were subjected to eight temperatures for 5, 30 and 60 minutes. Each test situation resulted in a metal square with markedly different color characteristics.

The single master chart (reproduced at left) was photographed in color with appropriate time and temperature labels and distributed to interested individuals. This is maintained by each member of the staff as a standard reference guide. Comparing a missile skin section with the photograph gives an accurate estimate of what temperature and time exposure that section was subjected to during a test.

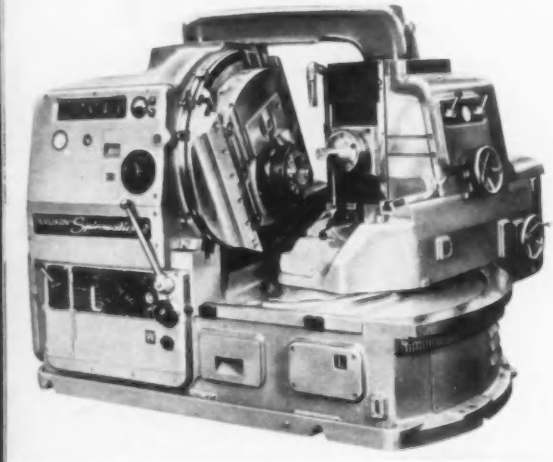
All examples of industrial photographs on these pages were reproduced from original negative transparencies supplied by the indicated companies. ■

Pistons with varnish deposit . . .
Standards established by oil and auto companies start with No. 10 (no varnish visible) and rating numbers decrease with larger amounts of varnish. These photos are of actual test pistons. (Courtesy: Gulf Oil Corp.)

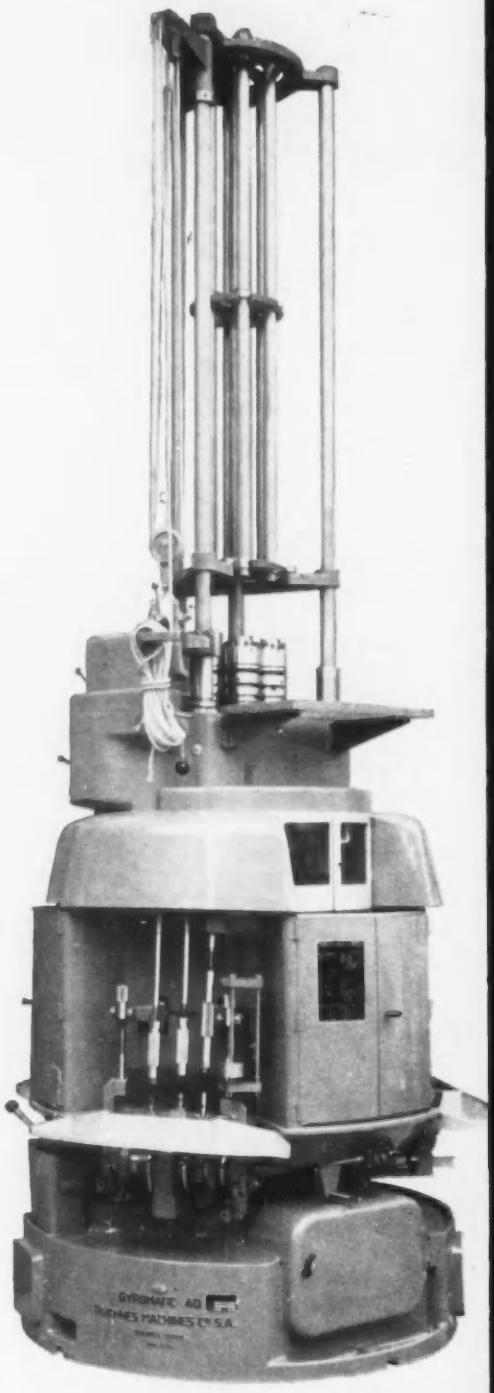
TRENDS

MODULAR CONSTRUCTION OF SPACE HEATER permits production of different-size units from same basic components. Designed and produced by LUWAAG, Zurich.

SIX-SPINDLE AUTOMATIC LATHE for chucking and bar work requires little floor space. Vertical gravity feed of stock eliminates radial loads and reduces friction and wear. Designed by the manufacturer, Tavennes Machines Co., S. A. Tavannes.



SPIRAL BEVEL-GEAR GENERATOR incorporates traditional Swiss precision with good industrial design to simpify operation and reduce operator fatigue. Designed by the manufacturer, Oerlikon Machine Tool Works, Buehrle & Co., Zurich.



"Contemporary American and Swiss design are in many respects related. This is explained by the fact that the way of life in the two countries is so similar, and that the standards of industrial production are more or less the same. Both the Americans and Swiss have a strong feeling for the practical, the useful, and for sound technical execution and good, simple design . . . It is well known that consumer goods, architecture, and town planning are the outward expression of the civilizing and cultural efforts of a country. Consequently, we in Switzerland are very impressed by the achievements of the United States in

in appearance design...

. . . IN SWITZERLAND

Circular tag is attached to products selected each year by Swiss and foreign experts of the Swiss Industries Fair, Basle, as outstanding examples of good design

CONTROL KNOBS OF KITCHEN RANGE are set on inclined-recessed panel for increased visibility and accessibility. Knobs light up when switched to any one of 8 heat positions. Designed by Alfred Altherr for Prometheus, AG of Liestal, (Basle).

FOOD MILL AND MIXER is multipurpose unit for European market. Functional appearance is result of housewife-consumer requirement for a dependable power tool to perform numerous hand operations—grinding, mixing, grating, juice extraction, etc.
Food preparation is more involved, requires more complex equipment in Europe where pre-prepared foods are not as common as in US.
Mixer is works design of manufacturer, Bruno Stamm & Co. Schaffausen.

the last 10 years . . . proving that a very intensive . . . social, economic, and cultural development is in progress.

"One may make a similar claim for Switzerland. Immediately after the Second World War an economic boom started here such as had never previously been known. . . . The immediate outcome can be seen in the intense building activity, the production of consumer goods and the industrial production destined for home consumption and for export (machines, apparatus, textiles, watches, etc.)".

These words by Professor Alfred Roth, President of the Swiss Werkbund, accompany the "Good Design in Switzerland" exhibition at present touring the States. The Werkbund promotes good design among both manufacturers and consumers.

The principal difference between Swiss and US design is that the Swiss designers must produce forms that are not quickly dated. Swiss production does not follow the yearly model system popular in the US. American designers can count on next year's model and use current styling trends, knowing that they will appear dated in a short while. This leads to a conservatism in Swiss design that rejects excessive use of ornamenation or abstract form.

ANNOUNCING

SILNIC (T.M.)

BRONZE BY CHASE®

NEW... Nickel Silicon Bronze that combines high tensile and high yield strength with high conductivity, excellent cold-forming characteristics and high corrosion resistance

Here's big news for every user of silicon bronze! New SILNIC(T.M.) BRONZE by Chase is absolutely unique—the *only* alloy in the silicon bronze family that combines strength, conductivity and excellent cold forming characteristics to give your products sales and performance advantages never before available.

Look at the comparison chart. See how Chase SILNIC BRONZE compares with the alloys you have been using...how SILNIC BRONZE—an age-hardenable nickel silicon bronze—gives you a combination of properties no other alloy can match! This new alloy is available in rod and wire. Get full technical details right now by mailing the coupon.

The booklet you will receive gives you the *facts* you need to evaluate this new alloy for your own use. In its pages, you will find listings of physical and mechanical properties; high temperature properties; corrosion resistance data; essential fabrication information. You'll find typical properties of some fabricated items reported, too.

New Chase SILNIC BRONZE has been thoroughly tested—in laboratories and on actual production jobs. Many months of work have developed full information about this new alloy. And it's all available for you!

So send in the coupon today for your free copy of the detailed Metallurgical Report on new SILNIC(T.M.) BRONZE by Chase. Or see your nearest Chase Representative at any convenient office or warehouse listed below. But don't delay—find out about SILNIC BRONZE now!

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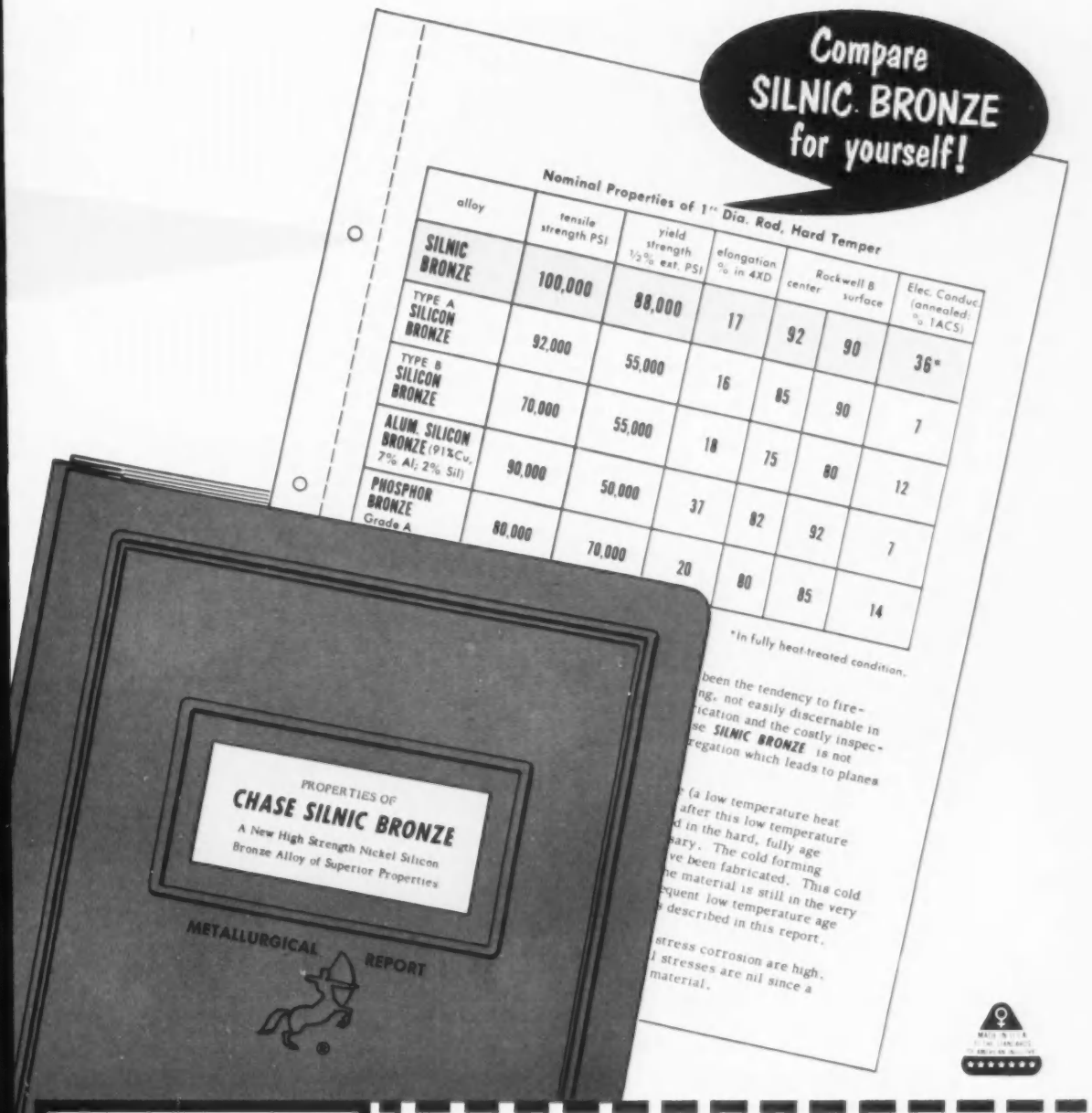
WATERBURY 20, CONNECTICUT
SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass, Copper and Stainless Steel

Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York (Maspeth, L.I.) Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury



MAIL TODAY!

Get the whole story on this amazing new alloy, Chase SILNIC BRONZE. Send for your FREE report on Mechanical, Physical and Fabrication Properties. Get all the information you need to evaluate SILNIC BRONZE yourself!

CHASE BRASS & COPPER CO. Dept. PE-558
Waterbury 20, Connecticut

☐ Please send me my FREE COPY of the metallurgical report on SILNIC BRONZE.
☐ I would like a Chase Representative to discuss SILNIC BRONZE with me.

Name_____

Company Name_____ Title_____

Address_____

City_____ Zone_____ State_____

SIGNIFICANT PARTS

Electro-hydraulic servo valve . . .

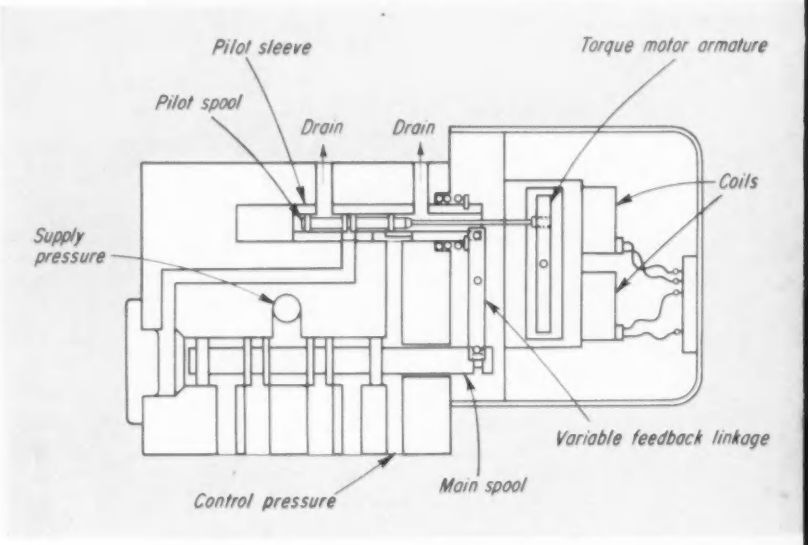
provides accurate flow modulation required for closed-loop program-controlled combinations of position, velocity and acceleration. Two-stage valve has four moving parts: a main spool, control spool, sleeve and feedback linkage, making valve flexible and compatible with various conditions of flow, response and pressure. A signal in milliamp range is required for control. Rated at 10-gpm max flow at 1000 psi, assuming ½ pressure drop across valve, and operates on supply pressure up to 3000 psi. Applications include machine tools, variable-speed driver or any hydraulic application requiring fast, closed-loop control of position, velocity and acceleration. **Vickers Inc., Detroit 32.**

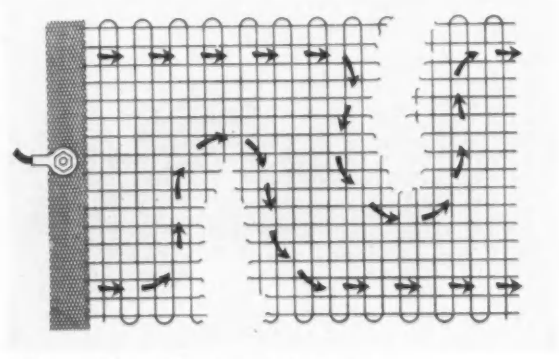
Circle 11, Reader Service Card

High-pressure storage bottles . . .

are made of continuous windings of glass fiber, epoxy-impregnated, and may be used to contain either a liquid or gas. Bottles are said to be suitable for 100 to 5000-psi pressure range, with service life ratings of 1000 to 10 million cycles. Current production of bottles with 870, 1330, 1770, 2570 cu in. capacities available for 30-day delivery. **Apex Reinforced Plastics, Div. White Sewing Machine Corp., Washington and Elm St., Cleveland 13.**

Circle 12, Reader Service Card





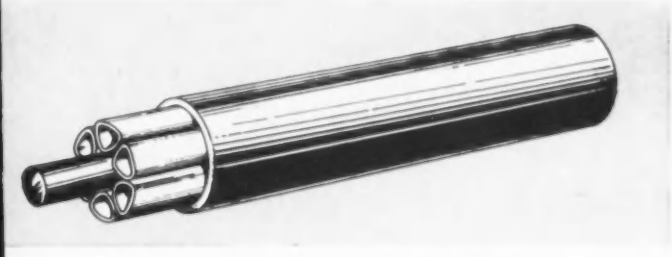
Self-mending heating element . . .

is made up of 36 wires per inch of heater width. Another continuous strand is interwoven perpendicular to circuit grid. This distributes current flow around any damaged area. Wire mesh is interwoven with glass or ceramic fibers. Weighs 1/10 lb per sq ft. Operates at 6 v dc to 220 v ac. Available as part of heating systems. Delivery about 4 wk after approving prototype. **Electrofilm, Inc., P. O. Box 106, N. Hollywood, Calif.**

Circle 13, Reader Service Card

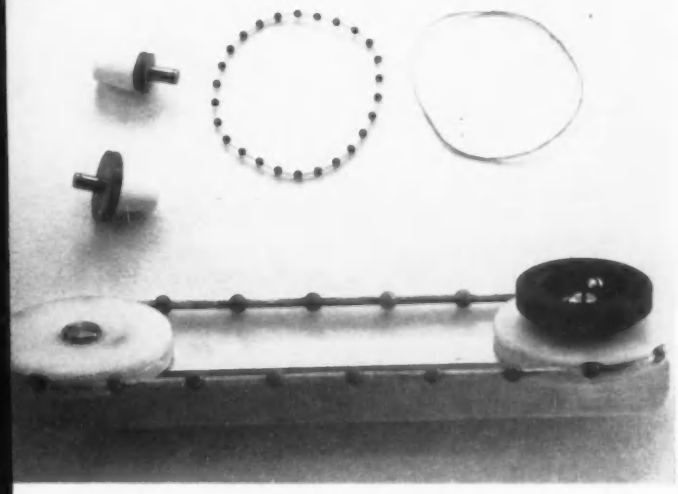
MATERIALS · EQUIPMENT

Semi-flexible transmission line . . .



is an aluminum-sheathed air dielectric coaxial cable developed to replace sectional air or solid dielectric transmission lines. Low attenuation is possible because of a cable design that places compressed, high-density polyethylene tubes closely about center conductor. Line is crush-resistant due to natural strength of aluminum sheath and added strength provided by continuous radial web support of dielectric tubes. Operates in temperatures of —130 to 482 F. Shipped in exact lengths. Available in nominal sizes of ⅜, ½, ⅞ and 1⅝ in. **Prodelin, Inc., 307 Bergen Ave., Kearny, N. J.**

Circle 16, Reader Service Card



Plastic transmission belts . . .

are said to provide slipless power transmission, positive engagement and power savings up to 35% compared with conventional transmission systems. Belts consist of an endless, wound, high-resistive core of plastic or fabric covered with coating of high-friction material. Nodes of plastic are injection molded to core at accurate intervals. Belts have been used to transmit up to 6 or 7 hp at speeds of 60 fps max. No heat develops between belt and pulley. For temperatures up to 212 F. Prices are reported to be 20 to 30% lower than V-belt systems. Delivery of samples in 4 to 6 wks. Made in Switzerland; **Rennpp Co., 3457 Greenfield Ave., Los Angeles 34.**

Circle 14, Reader Service Card

High-temp dielectric material . . .

consists of thin-walled, hollow-glass spheres ranging in size from 30 to 300 microns dia and resembling fine, white sand in bulk. Glass formulation gives stable performance to 1200 F. Softening does occur at temperatures above 1000 F, but no permanent change is noticed until 1550 F is exceeded. Dissipation factor is kept below 0.002 by special chemical treatment. The bulk product has a density of less than 20 lb per cu ft and dielectric constant is below 1.3. The material is now being used in high-temperature foams, high-temperature insulation and low-density casting and molding plastics. Priced at less than $5 per lb in quantity. **Emerson & Cuming, Inc., 869 Washington St., Canton, Mass.**

Circle 17, Reader Service Card

Plastic-metal bearing . . .

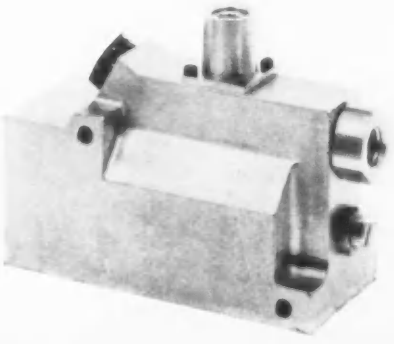
material exhibits low friction with no slip stick characteristics and with wear resistance said to be greater than other types of dry bearing materials. It is composed of a steel backing with a sintered bronze lining, impregnated with a mixture of TFE-fluorocarbon and lead. Material has compressive strength of up to 23 tons per sq in., temperature range of —392 to 536 F. Developed in England, now available in strip form (0.044, 0.059, 0.075, 0.091 in. thick) from which bushings, thrust washers, hemispherical bearings may be formed. Strips 18 x 4 in. range from $4.90 to $5.95 in production quantities, depending on thickness. **United States Gasket Co., Camden, N. J.**

Circle 18, Reader Service Card

Compensates for wear . . .

maintaining an established clearance between surfaces in abrasive contact, such as brake shoes and linings. Prevents thermal effects that would tend to change clearance. Port sizes are for ¼ in., but can be larger. Unit conforms to military specifications and although designed for 1500-psi brake service, higher pressure operation is said to be possible. 8-wk delivery; price for over 500 units, $150. **Hydra-Power Corp., 10-12 Pine Court, New Rochelle, N. Y.**

Circle 15, inside back cover



CHECK VALVE PRICES REDUCED

We have reduced the price of our regular Waterman Check Valve. Tell us your requirements to-day and take advantage of this price reduction.

These check valves are 3000 PSI operating pressure for oil, air or water.

They are of one piece construction—no welds or brazes to crack.

Nylon poppet assures trouble-free service.

Aluminum body and nylon poppets reduce the weight.

They afford minimum pressure loss through valve at rated flow.

ORDERING DATA	
MODEL NO.	PIPE SIZE
345-3	3/8" NPT
345-4	1/2" NPT
345-6	3/4" NPT
345-8	1" NPT

Write for Bulletin 5.01

WATERMAN ENGINEERING COMPANY

725 Custer Avenue **Evanston, Illinois**

SIGNIFICANT PARTS
MATERIALS
EQUIPMENT . . .

Rechargeable dry cell . . .
battery, using an alkaline lead oxide-silver system, is available in experimental production quantities. In uncharged state, it is estimated that cell can remain in storage for upwards of 10 years without loss of capacity. Maintains constant voltage in standby conditions for several years, and delivers rated capacity over a wide range of discharge rates. It withstands sudden drains of several milliamp without excessive voltage drop. Nominal output is 0.9 v; average capacity of present design is 1500 milliamp-hr. It is 1.190 x 0.591 in. high. **P. R. Mallory & Co., Inc., Indianapolis.**

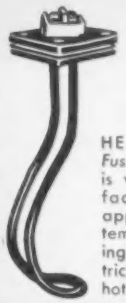
Circle 19, Reader Service Card

Constant-voltage supply . . .
replaces short-life dry cell batteries in various types of controlling, recording and indicating instruments without modification of the instrument. Dimensions of constant-voltage reference supply are the same as those of dry cell. In addition, two knurled positive and negative terminals correspond to those of battery. Three leads make connections to 115-v line and ground terminals within instrument. Operating at 1.5 v and 6 milliamp, unit has ±1% stability over ac line voltage variations between 105 and 125 v. Unit protects expensive equipment from damage caused by instrument failure due to a dead cell in control equipment. **Performance Measurements Co., 15301 W. McNichols Rd., Detroit.**

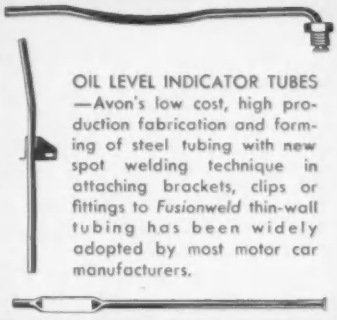
Circle 20, Reader Service Card

TUBING AIDS by Fusionweld

Spark Solutions to Production Problems

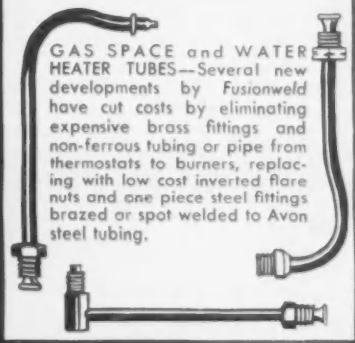


HEATING ELEMENTS—*Fusionweld* thin-wall tubing is widely used by manufacturers of electrical appliances containing low temperature calrod heating elements, such as electric irons, cookers, fryers, hot water heaters, etc.



OIL LEVEL INDICATOR TUBES—Avon's low cost, high production fabrication and forming of steel tubing with new spot welding technique in attaching brackets, clips or fittings to *Fusionweld* thin-wall tubing has been widely adopted by most motor car manufacturers.

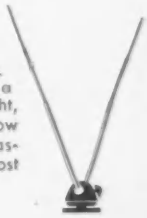
TUBULAR PUSH RODS—A current automotive development replacing solid steel push rods with *Fusionweld* steel tubing. These have swaged ends or hardened steel inserts (spot welded) in tubing ends. A high degree of concentricity is maintained with maximum run-out held to .020.

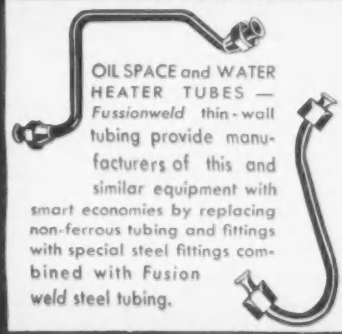


GAS SPACE and WATER HEATER TUBES—Several new developments by *Fusionweld* have cut costs by eliminating expensive brass fittings and non-ferrous tubing or pipe from thermostats to burners, replacing with low cost inverted flare nuts and one piece steel fittings brazed or spot welded to Avon steel tubing.

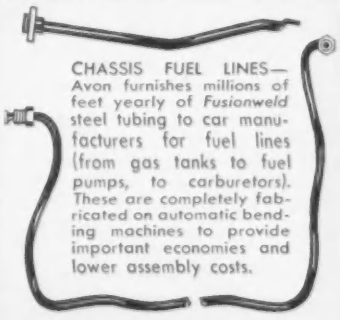
ENGINE OIL FILTER TUBES—For both internal and external use with brazed fittings attached. *Fusionweld* tubing can be beaded, swaged and sheared to meet specifications of motor car, truck and tractor manufacturers.

MISCELLANEOUS APPLICATIONS—*Fusionweld* thin-wall tubing is extensively used by toy manufacturers, umbrella and TV antenna makers, also for electric light fixtures, tubular furniture, etc. *Fusionweld* offers a tough, light weight, extremely ductile, low cost steel tubing easily formed for most requirements.

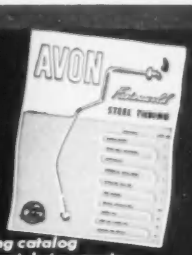




OIL SPACE and WATER HEATER TUBES—*Fussionweld* thin-wall tubing provide manufacturers of this and similar equipment with smart economies by replacing non-ferrous tubing and fittings with special steel fittings combined with Fusion weld steel tubing.



CHASSIS FUEL LINES—Avon furnishes millions of feet yearly of *Fusionweld* steel tubing to car manufacturers for fuel lines (from gas tanks to fuel pumps, to carburetors). These are completely fabricated on automatic bending machines to provide important economies and lower assembly costs.



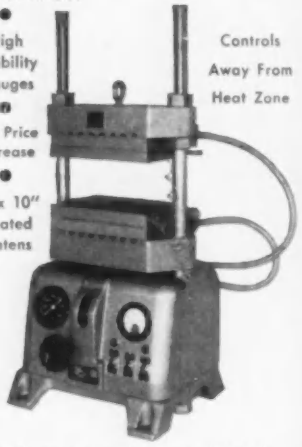
Our latest tubing catalog mailed on request. Let us quote on random or cut to length sizes—3/16 O.D. to 3/4 O.D.—plain or terne coated—or fabricated and formed to blueprint specifications.

AVON TUBE DIVISION
HIGBIE MANUFACTURING CO.
ROCHESTER • MICHIGAN

This new WABASH 12-TON Hydraulic Laboratory Press Pays Its Way On 101 Lab Jobs

Model 1210-N

- High Visibility Gauges
- No Price Increase
- 7" x 10" Heated Platens
- Controls Away From Heat Zone



Silent mercury relay—no chattering. Ask for Catalog 158

• Makers of Wabash Platens—Electric or Steam Heated—Water Cooled.

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1582 MORRIS ST.
WABASH, IND.

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Low-cost tooling. Extremely close dimensional tolerances. No Machining. No Waste. For information, see Sweet's Catalog, or write direct. Dept. A-52

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5454 NORTH WOLCOTT AVENUE
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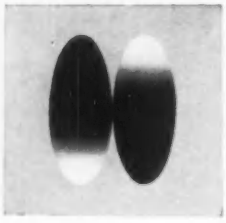
SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .

Miniature decade switch . . .

permits operator to read only numbers that are visible. Three or five decade units are available with contact ratings of 200 v and 1 amp. Features single and double pole, as well as binary-coded switch configurations for each decade. Desired switch position is selected by rotating knurled knob. Mounting of 1.84 x 1.75 x 1.87 in. unit is afforded by side brackets that permit flush mounting. For automatic control systems, computers and other systems requiring setting of numerical constants or coefficients. **Digitran Co., 45 W. Union, Pasadena, Calif.**

Circle 21, Reader Service Card



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ADVANCED MATERIALS TECHNOLOGY

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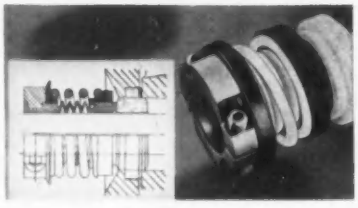


Bellows-type shaft seal . . .

has a Teflon bellows, integrally molded with a sealing face of filled Teflon. Springs which maintain contact sealing face are Teflon-sleeved. Sizes are from ¾ to 2 in. **Crane Packing Co., Dept. PEN, 6400 Oakton St., Morton Grove, Ill.**

Circle 22, Reader Service Card

Caulking compound . . .

is permanently flexible and ductile at temperatures of —30 F to 165 F and adheres to all surfaces. Black, puttylike compound gradually turns into a soft rubber after application. It is both a thermosetting and thermoplastic compound, based on co-vulcanization of a new synthetic elastomer with a selected asphaltic compound and addition of a hydrophobic component. Reports from four years of testing indicate no deterioration due to

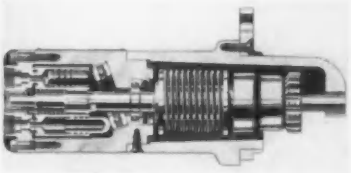
aging or weathering. Available at a cost of about one-third that of synthetic rubber caulking compounds. **Dittbrenner Associates, Inc., 18 Oneida Ave., Rockaway, N. J.**

Circle 23, Reader Service Card

Mounting screw . . .

eliminates retaining nuts, and incorporates two types of threads. Special point can be driven into a panel using left-hand threads, then standard right-hand machine screw threads form a stud. Component to be mounted is then positioned on stud and secured with a nut. Tightening this nut also tightens mounting screw, because of left-hand threads. **Shakeproof Div., Illinois Tool Works, St. Charles Road, Elgin, Ill.**

Circle 24, Reader Service Card



Hydraulic motor cranks . . .

marine or land-based internal combustion engines, drives propulsion components, actuates various types of machinery by storing hydraulic fluid under pressure in accumulator for one-shot, intermittent or continuous output. Hydraulic pressure against movable plungers (at left, in motor shown above) forces them against tilted ball bearing, causing unit enclosing plungers to rotate. Unit may be hand- or motor-driven. Four available models are rated for service with gasoline engines ranging from 800 to 3000 cu in., diesel engines of 300 to 2500 cu in.; operating pressure ranges, 1000-2000 psi. Weight ranges from 12 to 37 lb; dimensions, 3⅝ x 9⅛ in. to 7½ x 13⅜ in. **Hydrotor, Div. American Bosch-Arma Corp., 3664 Main St., Springfield, Mass.**

Circle 25, Reader Service Card

Flow switch actuates . . .

signals, pumps, burners, alarms, meters or similar equipment when flow of liquid in a pipeline starts or stops. Installed in a 1-in. pipe tapping, sensitivity to flow can be adjusted. Paddle, assembled in 1-in. segments, can be adapted to fit 1-in. or larger pipe sizes. Packless construction features heavy phosphor bronze bellows. All operating parts are brass, copper or bronze. Switch is magnet-assisted, snap-action design. Available in two UL models for line voltage and two for use with self-generating milliv systems. **McDonnell & Miller, Inc., 3500 N. Spaulding Ave., Chicago 18.**

Circle 26, Reader Service Card

Here's an excellent example of our ability to handle *tiny* wire cloth insert assemblies on a production basis. Of the three pieces involved:

a we punched out the tiny circular pieces of 100 mesh stainless steel cloth.

b we punched out the silver solder rings.

c we purchased on buyer's specifications the stainless steel recessed parts.

d assembled unit.

And to produce this tiny assembly we developed a unique method of induction brazing, necessary to get high production rates in the brazing operation.

We've fabricated many large insert pieces, some several feet across; also countless medium sized parts. We thought you might be interested in the type of work we do in the 'miniature' field. However, no matter the size or shape of the part you want assembled with a wire cloth insert, we shall be glad to carry it all the way through . . . help in design, best method of inserting, quote and produce.

This Bulletin describes our work in connection with wire cloth inserts. How many copies would you like for you and your associates?

NEWARK for ACCURACY

A complete line of woven wire cloth and wire cloth parts in all malleable metals..

Send for Catalog E

Newark Wire Cloth COMPANY

351 VERONA AVENUE • NEWARK • NEW JERSEY

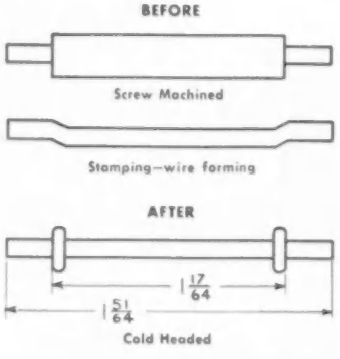
COST REDUCTION PROGRAM CALLS FOR COLD HEADING

Hassall Re-Design Often Means Big Savings on Parts

The most important consideration we can point out to the designer or purchaser of fasteners and small parts is that any part which can be machined from rod stock is also potentially available from the cold heading manufacturer. This technique offers speed of production, without scrap loss, plus superior strength and appearance for low cost and high design efficiency.

Perhaps our greatest contribution to your operation is our re-design service. An expert cold heading designer can very often study your drawings and come up with a modified part which will be lower in cost, stronger structurally, and easier for you to assemble.

This spacer is typical of such a Hassall re-design. Note the customer's drawing . . . this is a stamping, not too accurate, with poor bearing surfaces and not too easy to handle in assembly.



Now, look at this spacer as redesigned for cold heading. Now, a double collar spacer which is very accurate, structurally much stronger, and with much better bearing surfaces. And lower in cost!

Given complete specifications, including a drawing and an idea of the application, we can quickly tell you whether or not it will be advantageous to have your part or fastener JOB-DESIGNED by HASSALL.

Write today for your copy of our new Catalog No. 106.

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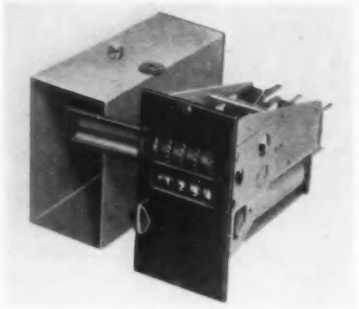
Manufacturers Since 1850

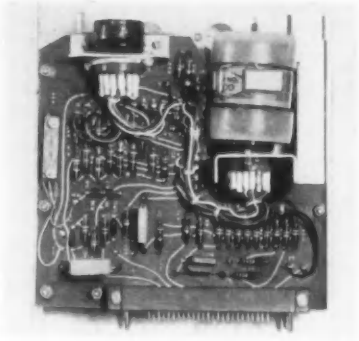
SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .



Counts from 0 to 9999 . . .

at speeds up to 25 impulses per sec. Tests indicate service life of at least 50 million impulses for the counter and up to 500,000 impulses for resetting system, which may be operated manually or electrically. Each impulse drives counting mechanism one step backwards until zero position is reached, when double-throw switch is operated. Counter is designed for operation with square dc impulses. Impulse duration and impulse interval are both 20 millisec minimum. Operating at 110 v dc, consumption for counting is 5.1 w; for resetting, 7.6 w. **Landis & Gyr, Inc., 45 W. 45 St., New York 36.**

Circle 27, Reader Service Card



Plug-in printed circuit units . . .

in modular form include as stock items multi-vibrators; high-speed binary and decimal electronic counters; stepping switches; operational amplifiers; storage devices for both short and long-term applications; pulse-shaping circuits; timing and delay circuits; diode logic "AND," "OR" and "NOT" circuits; gating circuits and transmission gates; relay and switching circuits; voltage regulators; pulse generators; clocks and gated oscillators; analog-to-digital conversion systems. **Dept. AC, Skiatron Electronics & Television Corp., 180 Varick St., New York 14.**

Circle 28, Reader Service Card

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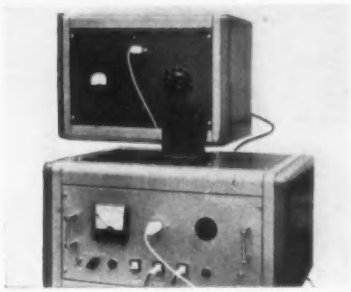

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can be synchronized within 0.001 microsec, according to manufacturer. Instrument is comprised of a Crown Graphic camera, electronically gated shutter unit, power supply and an electronic modulator. Plug-in pulse-forming networks are available to allow a selection of exposure times from 0.005 to 0.1 microsec. **Electro-optical Instruments, Inc., P. O. Box 4234, Pasadena, Calif.**

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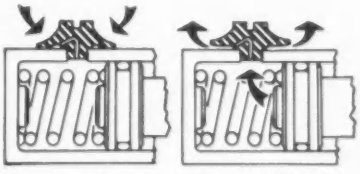

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permits excess or escaping gases to leave without sucking in contaminants in sealing applications. Nonmechanical valve has a new venting principle that has been developed to protect vital assemblies on liquid rocket engines, but can be applied to relief, check, safety and breather valves. **Developed by Rocketdyne; marketed by Navan Products, Inc., Santa Monica, Calif.**

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has a lead sharpener built into the removable cap. Made of light alloy, the pencil has a sand-blasted, non-slip finger-grip. Clutch-action chuck holds leads like as a vise does. Adjustable indicator denotes lead degrees. Leads are available in 14 degrees of hardness, 3B to 9H. **Reliance Pen & Pencil Corp., Dept. CP, 22 S. Sixth Ave., Mt. Vernon, N. Y.**

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NEW LITERATURE

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Published by D. Van Nostrand Co., Inc., Princeton, N. J. 11¼ x8¼, 1839 pp. $30.

Even in today's era of specialization it often becomes necessary for one specific branch of science to overlap another. When this occurs, terms common to one science are often misunderstood or entirely absent in the language of another. The 100,000 definitions in this encyclopedia effectively cross that bridge; they cover the gamut from aeronautics to zoology. The 37 contributing editors, representing the various segments of the scientific world, perform the necessary functions of up-dating some of the antiquated definitions—especially those in the fields of nucleonics, electronics and guided missilery—as well as providing the necessary explanations for some of the newer entries on the lexicographer's list.

The clear text is enhanced by more than a thousand illustrations in both color and black-and-white. This third edition effectively cross-references the 14,000 articles providing fundamental principles and practical applications for any chosen subject. The encyclopedia will find a welcome and much needed home on the shelf of any engineer, scientist or layman who wants the "what's" and "why's" of science.

It is curious that the editors have chosen to omit definitions of the words "science" and "engineering"; yet, these definitions might be a book in themselves.—BAL

ASME-AIEE Joint Engineering Management Conference*, Boston, Mar. 19-20

"Integrating Effort in Long and Short-term Programs," *by* G. R. NORTHRUP, *Philco Corp., (ASME paper 58-MGT-2)*, discusses methods of organizing and evaluating research, development and engineering organizations and programs. The paper relates this to the present trend towards diversification and development of product lines, opening of new markets, growth of competition. Means of determining how greatest return on investments in technical manpower can be obtained are discussed.

"Evaluation of Technical Programs," *by* L. W. BASS, *Arthur D. Little, Inc., (ASME paper 58-MGT-3)*, describes methods of coordinating and budgeting research, development, engineering, and of auditing results.

"Development of Engineering Personnel for Management Responsibility" *by* H. W. JOHNSON, *MIT, (ASME paper 58-MGT-5)*, discusses the question, "Do engineers make good managers?" Part of the answer is given in terms of the history and achievements of individuals. Management jobs open to engineers and how to prepare for such responsibilities are discussed.

"Competitive Position as a Measure of Engineering Progress," by O. E. RODGERS, *Utica Bend Corp., (ASME paper 58-MGT-6)*, reviews ways of obtaining information on competitive products and discusses how such data can be used in planning engineering programs. Several types of competitive situations are described.

*Copies of these should be requested from ASME, 29 W. 39th St., NYC 8.

PRE-COMPRESSED MOLDING—Brochure, 16 pp. Shows schematically how process works. Illustrated case histories discuss production rates, and characteristics of moldings, produced. W. R. Grace & Co., Polymer Chemicals Div., 225 Allwood Rt., Clifton, N. J.

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CHEMICAL MILLING—Brochure, 30 pp. Describes advantages and engineering applications; and process of chemical milling and finishing, with the operations involved shown both pictorially and graphically. Also included is information on color anodizing, anodizing, vacuum cadmium plating and other metal finishing processes. Anadite, Inc., 10630 Sessler St., S. Gate, Calif.

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This nylon fast-idle cam made by Chicago Molded for Holley offers less friction, and resists wear better than cams of low carbon steel. Furthermore, injection-molding it of nylon eliminates three operations – hardening, stamping, assembly – at production savings of more than fifty percent.

Holley is able to change the cam design without obsoleting the entire mold. That's because Chicago Molded designed a unique multiple-cavity mold made with removable sections. This permits easy changes in the number and sizes of the ratchets with very little expense, when the basic part is redesigned.

Designing and making molds that cut costs – and allow for low-cost changes – is a specialty of Chicago Molded's engineering staff. Why not find out if they can cut your costs? Ask, too, for a free subscription to *Plastics Progress* – the data-packed magazine on new developments in plastics. Write:

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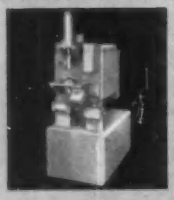

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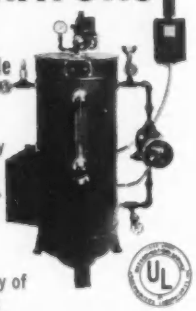

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Publisher's Postscript...

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You have no doubt noticed that a new reprint service was started in the Design Editions of PRODUCT ENGINEERING early in March. You now can get the reprints of articles you want quickly and without cost, by merely circling the key number of the article on the Reader Service Card in that edition.

The reprints available are listed at the top of the second page of the insert that contains the Reader Service Cards. Some of the reprints listed are from the current issue in which the insert appears, others from the two previous issues. This additional PRODUCT ENGINEERING service will enable you to keep your data files up to date without mutilating your copies.

In a year's time you can get as many as 104 separate reprints covering a broad range of topics of current interest in your day to day operations. On the same card you also can circle the key numbers that relate to new components or materials described in the editorial pages or those that refer to manufacturers' advertisements that appear in the issue.

If you were not one of the thousands that requested a copy, you can still get a complete editorial index to all the articles published in PRODUCT ENGINEERING during 1957 by merely writing "Send Index" on the blank lines at the bottom of the Reader Service Card.

You will notice too, that we have put a Reader Service Card in the R & D News issues, starting with April 21 issue. It appears on the facing page.

Our Reader Service Section under the able management of Catherine Kane has been enlarged to handle your increasing requests. Handling methods have been improved. You can use these cards with complete confidence that your requests will get prompt and careful attention and speedy action.

So now you will not only get the broadest, most complete, and fastest moving editorial service, but you will be able to get all the information you want for your files, with the least effort on your part. Do make full use of this helpful service.—A.H.

For Your Information (personal)

Get a wiggle?

The pages of newspapers across the country are blooming with ads for all sorts of vibrating pillows, shaking pads, and rocking beds. The country indeed seems about to be "all shook up." Some of these devices claim only to provide relaxation; but others aim at reducing weight, reproportioning the body, and easing the pain of arthritis and rheumatism.

The devices themselves are relatively simple in construction, and command prices of $5 to $500. Since there's almost no limit to the number of items that might be made to wiggle, it might seem like a good opportunity for product development—as well as something for personal use.

But, says the National Better Business Bureau: "With respect to 'spot reducing' . . . it has been well established that mechanical devices are utterly useless (and) . . . there is considerable question as to the value of mechanical massage devices in firming flabby tissues or improving muscular tone."

Furthermore, "Although massage may afford limited, temporary relief from minor pains associated with some types of arthritis in some cases, NBBB recommends that no product or device be advertised to the public for such purpose since arthritis is too serious and complicated a disease for self-treatment."

As to relaxation, NBBB reports, "There appears to be no question that some massage devices may exert a relaxing effect on some persons. There are other persons who might experience an opposite effect."

New fiber to suit you

By late next year, there'll be still another new synthetic fiber from which to choose when you set out to buy a new suit. Like so many of its predecessors, it will offer moth resistance, stability, crease retention, and wrinkle resistance. It also promises to be unusually strong, resilient, flexible, and resistant to ultraviolet light; and may offer exceptional abrasion resistance as well.

A polyester fiber, the newcomer has been named *Vitel*. It's an outgrowth of Goodyear Tire & Rubber Co.'s broad-scale research program on polyester resins that has already produced urethane synthetic rubbers, a new packaging and laminating film (*PE—Mar. 10, '58, p. 16*), and resins for coatings and finishes.

Goodyear will produce only the resin—not the fiber. But Beaunit Mills is now building a $10 million plant to spin staple, tow, and yarn.

card expires 7/5/58

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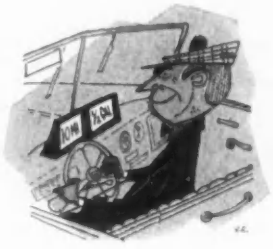

. . . a dashboard-mounted gage giving gas consumption in miles per gallon? A driver could modify his speed to establish most economical operation for long trips. The device would have to be accurate and react very quickly to changes in speed.

—A. H. LERCH

. . . permanent-magnet drive wheels for computer mechanisms? Normal friction drives rely on pressure loading which is difficult to maintain constant over linear distances, and influenced by wear. Magnetic attraction would be unvariable and relatively independent of external springs or gravity forces.

—E. A. KREMEYER

. . . casement window screens made of resistance wire with a low voltage applied along opposite edges so the screen will act as a radiant heating panel? Or how about a heater element strung between the panes of double-pane picture windows? Very little power would convert the chilly window into a warm, transparent wall.—T. N. TYLER and E. A. KREMEYER.

. . . a valve to be added to the hydraulic braking system of an automobile? If pressure fails to build up in any one of the four lines to the wheels, flow to that wheel is shut off. This permits the remaining wheel brakes to operate and the car to be brought to a stop. At present a leak in any line means no pressure and no brakes.

—C. MCLAUGHLIN

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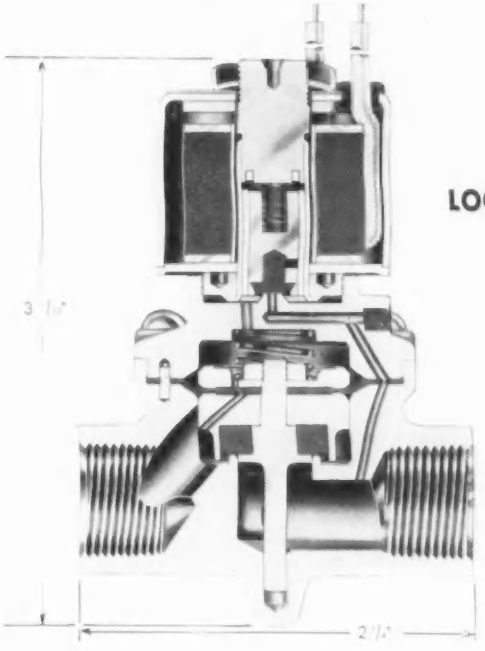
The valve handles pressures from 5 psi to 150 psi, with temperature ranges from —40°F to 180°F, and will operate on all popular AC and DC voltages. It's small but rugged, economical but efficient — manufactured to the highest engineering standards of the Skinner Valve line.

Versatility is also a feature of the new Skinner L Series; modifications are already available for normally open operation, with such options as manual override, explosionproof construction and choice of electrical connections to fit your application requirements.

You can get full details of this exciting, new valve line by writing us direct or by contacting the Skinner Representative or Distributor near you. He's listed in the Yellow Pages. Write Dept. 455

2-way normally closed shown actual size.



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- Unique Diaphragm Design — by actual test, this new design outperforms all others — the diaphragm is completely supported at all times. The nylon-reinforced buna diaphragm has a high resistance to media impurities, and only a small area is exposed to pressure, which assures long, trouble-free life.
- So Easy to Mount — so light in weight that it can economically mount directly to line.
- Operates upside down, sideways, in any position — strong spring action snaps valve shut — every time.
- Forged Brass Body — provides low porosity and dense metal structure for rugged application and no leakage.
- Low Wattage Consumption — coil consumes only 8 watts, considerably less than comparable valves.
- Soft, Synthetic Inserts — withstand constant opening and closing of pilot and main orifices — are long-wearing and provide absolute bubbletight operation.
- Internal Stainless Steel Parts — eliminate internal rusting, clogging or contamination.

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